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TECHNOLOGY AND DEFENCE

THIS WEEK-END, the people of Great Britain will in many different ways pay tribute to the memory of those who fought with such gallantry and sacrifice for our survival as a nation in the summer of 1940. What has come to be known as the Battle of Britain, which was fought to a finish in the skies above southern England, will be solemnly remembered on Sunday afternoon at the Thanksgiving Service in St. Paul's Cathedral after the customary ceremonial parade and fly-past over London. During these moments of remembrance, many thoughts will doubtless be turned not only to the stirring events of 18 years ago but also to some comparative contemplation of the present and to hopes for the future—a future that is inextricably linked with the fortunes of military and civil air power.

Tomorrow, on the eve of the more formal events marking the culmination of our annual commemoration of the Battle of Britain, the principal Service concerned opens its gates and plays host to the tens of thousands of people who want to see just how the modern Royal Air Force operates. Even if they cannot be shown the intimate details of the equipment at present in use, or be told all the secrets of future operational planning, they will most certainly come away convinced that the R.A.F. is a Service to be proud of and one that is far from becoming the automaton that protagonists of the automaticity of push-button warfare have prophesied.

It is, perhaps, particularly appropriate to find that during the past week the immense strides in military aeronautical development that have been taken since the famous Battle 18 years ago, have been emphasized by news of the R.A.F.'s latest V-bomber now established in squadron service. As we record elsewhere in this issue, the Victor is the most advanced of the trio of V-bombers which were conceived as the basis for our deterrent force capable of delivering a most formidable nuclear blow. But the Victor and its developments are likely to be the last of the large purely military front-line aircraft; their successors, we have been told, will be the large ballistic missiles carrying nuclear warheads. To begin with there will be the intermediate-range Thor missiles—acquired for operation by the R.A.F. from America under the Mutual Defence Aid Programme—the first of which arrived from the United States last week. Later will come our own long-range ballistic missile Blue Streak.

It seems especially timely, then, that developments in this latter more-distant direction have also been in the news during the week under review. As we discuss in the appropriate place in this issue, as a sort of postscript to the S.B.A.C. Display there has come some of the details of Britain's large ballistic research rocket known —in the current fashion of using colourful code names— as Black Knight. As a research tool for exploring the problems associated with ballistic flight through the outer fringes of our atmosphere and for establishing ways and means of ensuring that successful re-entry into the atmosphere can be achieved, Black Knight is important enough in its own right. But to many its real interest lies in its potentialities as a basis for much farther steps out into space. These hopes of some positive indication of official plans for such progress, however, have so far gone unsatisfied, for although the Minister of Supply explained that Black Knight could be developed into a multi-stage vehicle with which to put a "worthwhile" British satellite into orbit round the Earth, there were no indications that any definite moves towards this have yet been made.

On the other hand, however, although our planners may be tardy in making up their minds about Britain's space programme, our aeronautical engineers and scientists are not so slow in showing to the World that we can make a valuable contribution in this and in other directions. It is, perhaps, not without significance that out of 46 learned papers presented at the first International Congress of the Aeronautical Sciences recently held in Madrid—and encompassing such subjects as the physiological aspects of flight beyond the atmosphere, hypersonics, and the problems of vertical take-off and landing—no fewer than 10 were delivered by British speakers. And this contribution was exceeded only by the American effort—represented by 14 papers.

Here, we seem to have come a long way from the Battle of Britain and the comparatively straightforward defence pattern and the simple equipment which sufficed for its successful outcome. Certainly the equipment of the Royal Air Force has undergone some far-reaching changes and as time goes on will be transformed even more. As we have remarked before, however, there are clear indications that the Service departments are not entirely convinced that the day of the manned aircraft is over. But, even so, few will dispute the need in this day and age for a changing emphasis from manned aircraft to unmanned guided missiles as the primary weapons of defence and offence operated by the R.A.F. In many people's minds the only real point at issue is whether a more efficient and logical transformation might have been made by the introduction into service of an intermediate step in the form of the true mixed-powerplant fighter which has been sacrificed on the altar of economy.

MATTERS OF MOMENT

Comet Capability

MAKING, on its return flight from Hong Kong last Sunday, probably the fastest long-distance flight by any commercial airliner, the production Comet 4 has once again shown its prospective airline capabilities. Undoubtedly this flight, seen against the background of development effort, will stimulate more airline interest, and the problem now is likely to be that of finding ways and means of satisfying prospective customers.

In the course of building up the 100 hours of route flying necessary for its certificate of airworthiness, the Comet flew out last week in four stages to be present at the opening of the new runway at Kai Tak Airport, Hong Kong. With night stops at Cairo and Bombay this flight was a leisurely one, though the distance of 7,985 st. miles was covered in a flying time of 17 hr. 23 min. at an average speed of 461 m.p.h.

The plan for the return flight to Hatfield was that it should be made in one day—and in daylight. Favourable conditions allowed, before leaving Hong Kong at dawn, a flight plan to be made for a non-stop run to Bombay—overflying Bangkok, where a refuelling halt had been made on the outward journey. This sector distance, of 2,995 st. miles, is about 500 miles less than that between New York and London, which will normally be flown non-stop by B.O.A.C. when the Comet enters service later this year, but, without the favourable winds to be expected eastbound over the Atlantic, this flight was an impressive one. The monsoon-type weather at Bombay's Santa Cruz Airport was marginal, but Karachi could have been used as an alternative.

The original arrival time at Hatfield was given as 20.00 hrs., but, as it was learnt that Bangkok was overflown and as the flight progressed, the E.T.A. was brought steadily forward until it was finally known that the Comet could be expected at 17.30 hrs. Sure enough at about 17.20 hrs. we learnt that the Comet had left the airways and was due to arrive in about 10 minutes; at 17.37 the Comet was being held off along Hatfield's runway 24. A distance of 7,925 st. miles had been covered in a flying time of 16 hr. 16 min. at an average speed of 487 m.p.h.

Here are the details of the different stages and times.

Leaving Hatfield on September 8, this first production Comet 4, G-APDA, reached Kai Tak Airport, Hong Kong, on September 11 after a four-stage flight of 7,985 st. miles covered in a flying time of 17 hr. 23 min. (461 m.p.h.). The sector times were: London-Cairo (2,220 st. miles), 4 hr. 45 min. (467 m.p.h.); Cairo-Bombay (2,710 st. miles), 5 hr. 45 min. (471 m.p.h.); Bombay-Bangkok (1,870 st. miles), 4 hr. 10 min. (449 m.p.h.); and Bangkok-Hong Kong (1,185 st. miles), 2 hr. 43 min. (435 m.p.h.).

The distances, times and speeds for the return journey were: Hong Kong-Bombay (2,995 st. miles), 6 hr. 5 min. (473 m.p.h.); Bombay-Cairo (2,710 st. miles), 5 hr. 29 min. (496 m.p.h.); and Cairo-Hatfield (2,220 st. miles), 4 hr. 42 min. (472 m.p.h.). The total distance of 7,925 st. miles was thus flown in 16 hr. 16 min. (487 m.p.h.). Including the two refuelling and rest stops, of 60 min. at Bombay and of 66 min. at Cairo, the overall time was 18 hr. 22 min., giving an average, including ground time, of 432 m.p.h.

The return flight, which was started at dawn on Sunday, September 14, was interesting because it was made in only three stages and was completed entirely in daylight—the overall speed in a westerly direction, including stops, being more than sufficient to maintain daylight conditions for the 18¼ hours journey. The Comet, in fact, arrived at Hatfield with about two hours of daylight left.

In command was Mr. John Cunningham, with Mr. Peter Wilson as co-pilot. Among those on board during the return flight were Mr. Basil Smallpeice, managing director of B.O.A.C., and (on the Hong Kong-Bombay stage) Mr. A. C. Gazdar, technical director of Air-India International. With the aircraft on both out and home flights were two B.O.A.C. captains, A. P. W. Cane and R. C. Alabaster, who helped out on the flight deck.

At the opening of Kai Tak's runway the Comet carried, among others on an inaugural fly-past, H.E. the Governor of Hong Kong, Sir Robert Black, and the D.C.A., Mr. M. J. Muspratt-Williams. Among the other aircraft at the airport for the ceremony were a Britannia 102 of B.O.A.C. and a Britannia 314 of Canadian Pacific Airlines.

HATFIELD ARRIVAL.—As recorded on this page the first production de Havilland Comet 4 flew the 7,925 miles from Hong Kong to Hatfield in 18 hr. 22 min. elapsed time. Aboard the Comet on this proving flight was Mr. Basil Smallpeice, B.O.A.C.'s managing director, seen here with Mr. John Cunningham. In the group behind are Mr. F. H. M. Lloyd, Mr. A. S. Kennedy and Mr. R. E. Bishop.

The first Comet 4 for B.O.A.C. (G-APDB), incidentally, was flown to London Airport on September 12. Pending a full C. of A., it is on loan to the Corporation.

U.S.A.F. Accident Reduction

HEADED by Maj.-Gen. J. D. Caldara, Director of Flight Safety Research in the U.S.A.F., a team of American Service and civilian experts has been making a visit to the Third Air Force in the United Kingdom as part of its fourth tour of U.S.A.F. units in Europe. Holding no authority and capable only of making recommendations to the base commander, following an operations safety survey, the team also investigates aircraft accidents.

The team's work is to conserve the combat capability of the Air Force, and it consists of officers from the fighter, bomber and transport fields as well as specialists from the American aircraft industry. Its members spend approximately four months in every year on surveys to prevent accidents by going to the areas in the World where Service flying is undertaken.

Speaking on the U.S.A.F. accident record since 1945, Maj.-Gen. Caldara said that although the number of aircraft in service and the scale of operations had increased, the major accident rate had dropped; the major accident category in the U.S.A.F. is not comparable with the R.A.F. accident categories. In 1947 the U.S.A.F. major accident rate was 44 for every 100,000 hr. flown; in 1950 this figure was 36 per 100,000 hr.; so far this year the rate has been 10.8 per 100,000 hr.; 106 fewer aircraft have been destroyed this year compared with the same period for 1957.

Jet flying now accounts for approximately 35-40% of the U.S.A.F. total, and nearly 100% of all interceptor units are equipped with supersonic fighters. From the safety-factor angle, the American trend is towards twin-engined fighters with a crew of two. One U.S.A.F. fighter under flame-out conditions has a gliding speed of 243 m.p.h. and sink rate of 6-7,000 ft./min.

On navigation and automatic flying aids, the team considered that, while airborne electronic-equipment conception and design were keeping up with airframe developments, initial reliability

rate in new equipment was not maintaining a high enough standard. A third of the cost of an average military aircraft was in electronics. Operational ground navigation aids are not considered to be far enough advanced for the present aircraft speeds, and the position would not improve until data processing comes into service with the U.S. air traffic control system in the mid-1960s.

There are stated to be approximately 200,000 military and civil flights per day in the United States and an all-round airborne anti-collision device in the pilot's cockpit is required.

Sales Potential for a New Engine

POSSIBLE uses for the new Rolls-Royce R.B.145 turbojet engine, seen for the first time at the S.B.A.C. Show, are not immediately obvious. Suggested applications are for trainers or executive aeroplanes, and it would appear that there may be a bigger market for the engine on the other side of the Atlantic than on this.

It would be unlike Rolls-Royce to produce, as a private venture, an engine without being fairly certain of a need for it in the World market.

So far as is known, there is no requirement for a successor to the Jet Provost and it is doubtful if development of a military executive jet is justifiable in this country. The home market, therefore, does not appear to be particularly promising—even allowing for a variety of design studies using such an engine. More immediate uses for the R.B.145 could, however, be the Jet Provost itself, the Canadair CL-41, later Jindiviks or other target drones.

The interesting possibility which presents itself is that Rolls-Royce might be thinking of sales in America through their associate, the Westinghouse Electric Corporation, with whom they have had an agreement since 1953. This link-up has resulted in production of the Westinghouse J81 (based on the Rolls-Royce Soar) for the Radioplane XQ-4 target drone, and the J54 turbojet, which appears to be a scaled-down version of the 200 Series Avon.

The market for small turbojets—the R.B.145 has a thrust of 2,750 lb.—is opening in the U.S.A. with the development of such aeroplanes as the Lockheed Jetstar, North American Sabreliner, McDonnell 119 and various jet trainers. American engines under development for these aircraft are the General Electric J85 (2,500-lb. thrust), the Fairchild J83 (2,000-lb. thrust) and the Pratt & Whitney JT-12 (2,900-lb. thrust).

The JT-12 is a private-venture engine for missile and drone applications, although its high power/weight ratio, 6.75 : 1, would be very attractive for subsonic applications. The J83 and J85 are now experiencing certain teething troubles and it seems likely that one or the other will be dropped by the U.S.A.F. which is at present providing official backing.

Into this scene, then, the R.B.145 might make a profitable entry under the Westinghouse banner.—D.G.

First 707 Services

AS we were going to press with this issue Pan American announced plans for the first Boeing 707 services. A New York-Paris-Rome service will be flown daily from October 26; and daily New York-London services are due to start on November 16.

The services will leave Idlewild at 10.00 hrs. local time, arriving at London Airport at 21.35 hrs., and will leave L.A.P. at 11.00 hrs. and arrive at Idlewild at 14.45 hrs. local time. B.O.A.C.'s Comet services are expected to leave L.A.P. at 10.15 hrs. and to leave Idlewild at 22.00 hrs. The Boeing journey times, as scheduled, are 6 hr. 35 min. eastbound and 8 hr. 45 min. westbound.

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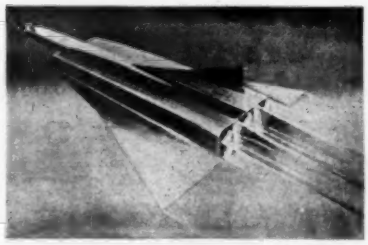
UP AND DOING.—The red-and-white colours of the Central Flying School's Hunting Jet Provosts have been a familiar sight throughout the country this year, when a series of beautifully clean aerobatic demonstrations has been given. The team will be seen again tomorrow—Battle of Britain Day. Some more pictures are on page 468.

Photograph copyright "The Aeroplane"

News of Aircraft, Engines and Missiles

KAMAN ROTODYNE.—A version of the Fairey Rotodyne is the Kaman entry for a U.S. Army helicopter competition. Requirement is for a 6,000-lb. payload; the Rotodyne already has a 15,000-lb. payload. A demonstration of the Rotodyne in the U.S.A. would seem to be a good idea, in these circumstances.

NEW EXECUTIVE VISCOUNT.—Vickers now offer their basic Viscount 762 Executive model with either Dart 510 or Dart 520 engines. With the latter engines—at present used only in the Viscount 800 series aircraft—the cruising speed is 365 m.p.h. To supplement normal fuel capacity these Viscounts can carry two 145 Imp. gallon slipper tanks and a 456 Imp. gallon fuselage tank in the forward lower luggage hold. Carrying the maximum possible 2,650 Imp. gallons, the Viscount 762 with Dart 520 engines has a range of 2,900 statute miles carrying 10 passengers.



COMMERCIAL PROJECT.—This artist's impression is of a supersonic airliner envisaged by Bristol Aero-Engines, Ltd. It is powered by a combination of turbojets and ramjets which give it a Mach 2.5—3.0 performance at 60,000 ft. Some details of the project appeared on page 427 of our previous issue.

MACH 4.0 RAMJET.—A Lockheed X-7 ramjet powered missile has flown at Mach 4.0. Launched from an aeroplane, the X-7 was rocket-boosted to supersonic speed before the ramjet was lit. It eventually became so hot that part of the ramjet burned away.

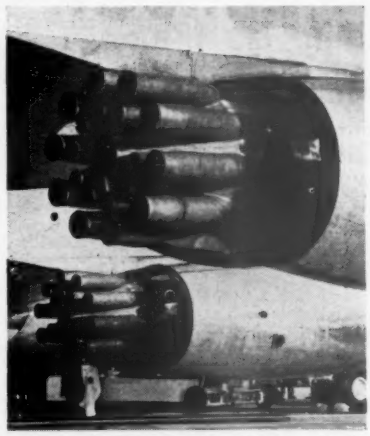
BLACKBURN B.107B.—Designation of the commercial transport variant of Blackburn's current turboprop freighter study is B.107B. On four Rolls-Royce Tynes it will cruise at 306 knots at 25,000 ft. and will carry 60,000 lb. of freight over 1,500 naut. miles, or 39,300 lb. over 3,000 naut. miles. An auxiliary floor can be fitted for passenger carrying. Details of the military B.107A appeared in THE AEROPLANE for August 29.

PEMBROKE ORDER.—Hunting Aircraft has announced that an order for the Pembroke general-purpose transport aircraft has been placed by the Sudan Air Force. The type is already operated by seven air forces.

FIRST FLIGHT.—The Garland Bianchi Linnet, G-APNS (90-h.p. Continental engine), made its first flight at Fair Oaks on September 1, piloted by Sqn. Ldr. Neville Duke. It flew for an hour, and three take-offs and landings were made. It has since done all of its A.P.1090 tests and the pilot's comment is that it is "delightful."

NEW SKYWARRIOR.—The Douglas A3D-2P, a long-range photographic-reconnaissance version of the A3D Skywarrior, is being tested at Edwards A.F.B. The first flight was made on July 22 between Los Angeles and Edwards. The type is in production at the Douglas El Segundo Division. The A3D-2P is a carrier-based nuclear bomber with a completely redesigned fuselage, cockpit and wings. Two Pratt & Whitney J57 turbojets are fitted. Span is 72.5 ft.; length, 75.5 ft.; height, 22.8 ft.

FAIRCHILD REORGANIZE.—A commercial transport division has been set up by Fairchild Engine and Airplane Corpn., to separate F-27 production and sales from the company's military activities. Heading the new division as a company vice-president is Mr. J. H. Carmichael, until recently president of Capital Airlines. Mr. James Pfeiffer has been appointed vice-president, marketing, for the new division, and Mr. Richard Palmer is vice-president, communications.



Photograph copyright "The Aeroplane"

RUN-REDUCING.—The Boeing-developed thrust reversers seen for the first time on the Boeing 707 which recently visited London are of the cascade type with internal clam-shells.

FLUORINE FUEL.—First large-scale rocket thrust-chamber firings using liquid fluorine as an oxidizer have been made by the Bell Aircraft Corpn. This type of fuel may be used for the Dyna-Soar orbital bomber.

A.S.M. AGREEMENT.—Large industrial gas turbines designed by the Clark Bros. Co. of Dresser Industries, Inc., in the U.S.A. are to be built under licence in England by Armstrong Siddeley Motors, Ltd. The Clark Model 305 and 302 gas turbines are of 8,700 and 9,300 b.h.p. continuous rating.

MORE RATIONALIZATION.—The Hawker Siddeley Group are to integrate the affairs of their subsidiary, the Brush Group, completely with the parent group. Although the Brush factories will continue to manufacture and sell their own products under their own names the board of the Brush Group has ceased as an executive body.

Commercial Aviation Affairs

ANGLO-AMERICAN.—The Lockheed Jetstar has now amassed over 500 hr. flying since the first flight on September 4, 1957. During trials, the Orpheus-engined Jetstar has reached Mach .92 in level flight, has climbed to 52,000 ft. and—with the 640-U.S. gal. sleeve tanks shown here—has flown 3,105 miles non-stop.

ATLANTIC COMETS.—B.O.A.C. intends to introduce the Comet 4s on the London-New York service with 16 de-luxe seats and 32 first-class seats. Earlier the plan had been to have an all-de-luxe layout with 40 seats.

BRITANNIA UTILIZATIONS.—Before the end of August, B.O.A.C.'s 15 Britannia 102s were averaging 10.1 hr. flying a day or 3,686 hr. per annum per aircraft. The utilization of the 312s on the North Atlantic and South African services had risen to 2,154 hr. per annum per aircraft with 14 in service.

GATWICK TRAFFIC.—During June, Gatwick Airport (reopened on June 9) had 1,449 movements and handled 27,554 passengers.

CJ-805 CERTIFICATE.—On September 9, the C.A.A. announced that it had certificated, for commercial operation, the General Electric CJ-805-3 turbojet to be used in the Convair 880. The CJ-805-3 delivers approximately 11,000 lb. s.t.

F.A.A. CREATED.—On August 23, the U.S. President signed the bill which creates a Federal Aviation Agency as an independent body to absorb the functions of the C.A.A., the Airways Modernization Board and portions of the C.A.B. An Administrator is not yet appointed.

BOEING 707 PRODUCTION.—By last week, Boeing had rolled-out the six Boeing 707-120s for P.A.A., and four for American Airlines, and had six more for American and three for T.W.A. in final assembly, together with the first two long-range 707-320s for P.A.A. The first American 707-120 is to fly this month but introduction into service is now scheduled for early 1959. American accepted a six-week delay in delivery (from September 1 to October 15) so that Boeing could incorporate modifications.

THE 707 AT IDLEWILD.—The Port of New York Authority has extended, for 30 days from September 5, the period during which P.A.A. will be able to operate trial flights with the Boeing 707 in and out of Idlewild.

GHANA'S FLEET.—Two D.H. Herons and one DC-3 have so far been purchased by Ghana Airways for regional operations when W.A.A.C. ceases to exist later this year. B.O.A.C. is already operating services for Ghana Airways between Accra and London.

VISIT FROM ARGENTINA.—Air Cdre. Juan José Guiraldes, president of Aerolineas Argentinas, on the flight deck of the Comet 4. In the co-pilot's seat is Air Cdre. A. H. Wheeler of the Air Registration Board. The airline's plans for the Comet were outlined in last week's issue.

FAST CROSSING.—On its return to the United States after tests at L.A.P., Pan American's Boeing 707-120 flew non-stop from Stansted Airport, Essex, to Idlewild, New York, in 7 hr. 29 min. Stansted is well away from heavily built-up areas and has an ample U.S.A.F.-built runway (10,000 ft.) so the maximum take-off weight (247,000 lb.) could presumably be used. Assuming that the 707 followed a Great Circle track, the block-to-block speed was about 400 knots (460 m.p.h.). On September 12, the Boeing 707 flew from New York to Le Bourget, via Gander and Keflavik, in 8 hr. 45 min.

DOUGLAS BUY-BACK DEAL.—Details have been given by Douglas Aircraft Co. of their plan to buy back from United Air Lines 10 DC-7s between November, 1959, and August, 1960, in connection with their sale of DC-8s to U.A.L. Agreed price for the DC-7s is $1,250,000 each less $5,000 for each month in service with U.A.L.—or about $1 million each.

COMMONWEALTH CONFERENCE.—Current problems of air transport in the Colonies were discussed at a conference in London between September 5 and 10. Most of the territories were represented by their D.C.A.s, and the matters discussed included the requirements for longer and stronger runways and taxi-ways, landing aids and passenger handling at the airports consequent upon the introduction of jet airliners on routes through the Commonwealth.

News About People

D.H. APPOINTMENT.—Mr. Philip Lucas, G.M., F.R.Ae.S., has been appointed assistant to the managing director of The de Havilland Aircraft Co., Ltd. His future address will be c/o Saunders-Roe, Ltd., 45 Parliament Street, London, S.W.1. (Tel., Trafalgar 5448.) He will now be responsible for advising the managing director on current military and civil policy and for liaison with Services at home and overseas, and maintain liaison with civil operators in the Commonwealth and other countries. In addition he will act as sales adviser to Saunders-Roe.

BOEING SALES.—Mr. John K. Broback has been appointed assistant manager of export sales at the Boeing Airplane Co.'s transport division. He was formerly chief of operations, engineering, and now has responsibility for Boeing jet airliner sales in Mexico, Central America, Venezuela and Colombia.

MINISTRY POST.—Mrs. Alison Munro, who has been appointed under-secretary of the Air Services and Civil Aviation International Relations Group at M.T.C.A. She has been with the Ministry since 1945.

R-R RESIGNATION.—Mr. John Parsons has resigned his appointment as assistant general works manager of Rolls-Royce, Ltd., Derby, to join the board of directors of Richard Lloyd, Ltd., Birmingham and Tenbury Wells.

NEW EDITOR.—Mr. Allan Bernhardt has been appointed editor of *Aero/Space Engineering*, published by the Institute of the Aeronautical Sciences. He was formerly associate editor, and succeeds Mr. Welman A. Shrader, who will in future concentrate on duties as director of I.A.S. publications.

HELICOPTER HONOURS.—Mr. Igor Sikorsky, the helicopter pioneer, and Dr. J. A. J. Bennett, Professor of Aerodynamics at the College of Aeronautics, have been honoured by the Helicopter Association of Gt. Britain by being made Honorary Members.

F. O. HICKLING.—We regret to record the death of Mr. Frederick Osgood Hickling, technical manager of the Ransome and Marles Bearing Co., Ltd., for the past 30 years.

Military Aviation Affairs

BRITISH ALOUETTES.—Two Sud-Aviation Alouette 2 helicopters have been bought for evaluation by the British Army and will later be tried out in Germany. The sale was negotiated by Helicopter Sales, Ltd.

NATO INTEGRATION.—At the suggestion of SHAPE the Dutch and Belgian Air Forces are to be integrated by 1960. The preliminary training of pilots will continue in the country concerned, but advanced training will take place at Kamina Air Base in the Belgian Congo. Fighter training is to be undertaken in the Netherlands.

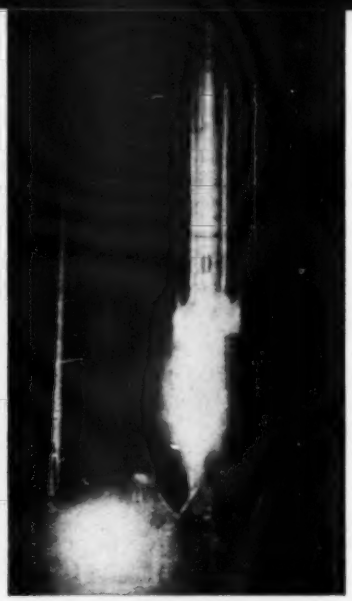
THANKSGIVING SERVICE.—The annual Battle of Britain Thanksgiving Service will be held in St. Paul's Cathedral Sunday, September 21, at 15.15 hrs. H.M. The Queen will be represented by Air Chief Marshal Sir George H. Mills, Commander, Allied Air Forces Central Europe. For the first time the R.A.F. will have precedence over the Army in the parade connected with the Service. The annual R.A.F. London exhibition on the Horse Guards' Parade is being held this week.

THOR ARRIVES.—The first Thor IRBM has arrived in the U.K. Transported from the U.S. by air, it arrived at the U.S.A.F. base at Lakenheath for later movement by road to the R.A.F. missile site near Feltwell, Norfolk.

H-BOMB TEST.—A British hydrogen bomb was successfully exploded at a high altitude over Christmas Island in the Pacific Ocean on September 11. It was dropped from a Vickers Valiant commanded by Sqn. Ldr. G. M. Bailey.

S.A.C. BOMBING COMPETITION.—Bomber Command has accepted an invitation to take part in the U.S.A.F. Strategic Air Command Bombing and Navigation Competitions to be held in California in October. Two teams, each consisting of four Vickers Valiants, will be entered by the R.A.F.

FIAT G.91 NEWS.—The Tactical Experimental Group of the Italian Air Force equipped with the Fiat G.91 light fighter (Bristol Orpheus turbojet), has already completed more than 1,000 hr. of flying. Fourteen aircraft have been delivered and a further 16 should be in service by the end of this year. Germany is to build 100 of this type under licence, and about 50 are to be built with M.D.A.P. funds for Greece and Turkey. The company also expects an Austrian order for 20.



Atmospheric Knight-errant

WITH the sudden success of the Black Knight ballistic research missile, which worked first time and did just what was expected of it, Britain has—to quote the Minister of Supply, Mr. Aubrey Jones—made her "first real entry into space." Plans are afoot for two-stage and three-stage versions and it is possible that a British satellite will be put into orbit within a year or so.

A Black Knight was launched from the Woomera range on Sunday, September 7, and reached a height of about 300 miles before returning to Earth in the selected target area about 60 miles from the launching site. The nose-cone fragments have been recovered and data obtained during its flight are being evaluated in Australia.

The most significant and important aspect of this success story is that it is one of close teamwork by Government establishments and private companies. Technical responsibility for the Black Knight has been under the direction of Mr. D. J. Lyons, B.Sc.(Eng.), A.F.R.Ae.S., director of the Ballistic Missile Division of the Royal Aircraft Establishment, Farnborough. The missile was built by Saunders-Roe, Ltd., in collaboration with this Division of the R.A.E.

Propulsion is by a liquid-propellent rocket engine made by Armstrong Siddeley Motors, Ltd., from an original design by the R.A.E. Rocket Propulsion Division at Westcott of which Mr. J. E. P. Dunning, M.A., F.R.Ae.S., A.M.I.Mech.E., is chief superintendent.

However, much of the credit for the success of the whole project must go to Dr. G. W. H. Gardner, C.B., C.B.E., D.Sc., M.I.Mech.E., F.R.Ae.S., who has been director of the R.A.E. since 1955, having previously been Director-General of Technical Development (Air) at the Ministry of Supply. Mr. Gardner joined the R.A.E. in 1926, and since 1945, when he became Head, Controlled Weapons Department, has been very closely concerned with the development of guided weapons.

On the industry side, Mr. M. J. Brennan, B.Sc., M.I.Mech.E., F.R.Ae.S., is chief designer at Saunders-Roe, Ltd., and Mr. S. Allen, M.I.Mech.E., F.R.Ae.S., is chief engineer of Armstrong Siddeley Motors, Ltd. To complete the picture of co-operation, de Havillands lent a team at Woomera to assist in the launching procedure.

Details of the Black Knight

On seeing a Black Knight for the first time one's immediate reaction is surprise at its simplicity of appearance. The main body section is a parallel tube topped by a straight-tapered nose-cone with spherical tip. At the base is a four-finned power-plant section containing the rocket engine. The length is about 35 ft. and the body diameter about 3 ft.

The secret of the Black Knight's success is largely in the high proportion of propellent weight to total weight. This has been achieved by dispensing with a separate structure and forming the body by stacking a number of integral tank cells on top of one another. Immediately on top of the finned engine section is the fuel tank which takes up more than half the total length of the missile, about 18 ft. 6 in. The oxidant tank occupies a further 4 ft. of its length. Four external supply lines from the fuel tank and two from the oxidant tank run down the body to connect with the engine. The fuel cells are doubtless pressurized to maintain structural integrity when empty.

The last section of the cylindrical body, immediately under the nose-cone, is an electronics bay about 1 ft. 4 in. deep. The nose-cone is about 6 ft. from base to tip. From it project a whip aerial and what seem to be two rigid antennæ.

The Black Knight's structure appears to be all of light alloy, with the exception of the nose-cone which is apparently covered by a sheath of resin-bonded glass-fibre to give heat-resistance on re-entering the Earth's atmosphere. It is thus not possible to surmise the type of metal used although stainless steel is a likely choice.

The finned base section containing the engine is of very simple construction and round-head rivets are used, the remainder of the missile being either flush-riveted or resistance-welded. The four fixed fins have a compound-wedge front profile and a single-wedge rear profile to the aerofoil section.

At the tips of two of the fins flare canisters about 4 ft. 3 in. long are mounted in diametrical opposition. These have conical noses of nearly half the length of the canister. In the plane of the fin leading edges are eight holes for access when preparing the missile for launching. Seven of these are circular hand-holes and the eighth is enlarged to an oval shape to allow a man to get his shoulder inside and reach farther in.

Electrical connections to the missile are through two pairs of plug-and-socket connectors. When the engine thrust exceeds the weight and the missile rises, the plugs are withdrawn automatically by tie-rods attached to the launching pad. These rods are counterbalanced and fly out and away from the missile as it rises.

Similar counterbalancing is used to ensure that four steadying stays, or "wind shears," which keep the missile in an accurately upright position before launching, do not impede its progress. They fly out and are restrained by spring-loaded pads mounted on the four corner stanchions of the launching pad.

Powerplant Arrangements

Little is known of the rocket engine, whose correct functioning, as one knows from failures in other countries, is so very important for successful launching of the missile. There are four main exhaust nozzles and four smaller nozzles in a double four-leaf-clover arrangement. The four large nozzles fire all the time the engine is running and are gimbal-mounted for directional control, the missile fins being fixed. The four small nozzles are for trimming purposes and are used as required to maintain the desired trajectory.

It is almost certain that the Armstrong Siddeley rocket engine uses liquid-oxygen oxidant and kerosene fuel. R.A.E. Westcott has done a lot of work on engines of this type and Armstrong Siddeley Motors have unrivalled experience in designing and producing such engines, of which the Screamer is a recent example.

So far as the trimmer rockets are concerned, it is significant that the Armstrong Siddeley PR.23 liquid-propellent rocket of 500-lb. thrust was shown at the recent S.B.A.C. Show. It was stated then that one of its uses could be as a missile trimmer.

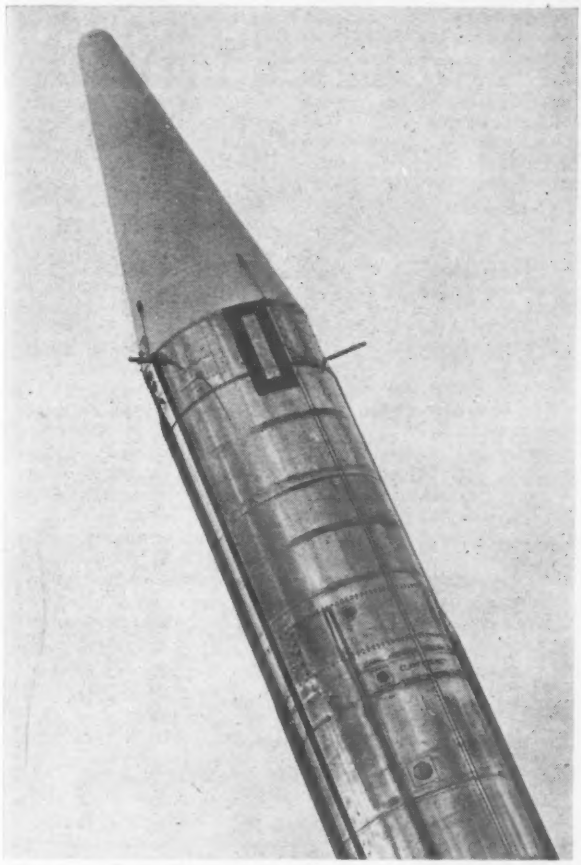
In its present single-stage rocket form, the Black Knight has reached a height of 300 miles. With a solid-propellent second stage added it should be possible to reach altitudes of 600 to 1,500 miles and it would be feasible to launch a satellite by using a solid-propellent third stage. A two-stage Black Knight is in fact being developed by Saunders-Roe in collaboration with the R.A.E.

Work on the Black Knight began about two and half years ago and to date the programme has cost less than £5 million. A total production of about two dozen such missiles is envisaged at present.

The programme is for research into ballistics and atmospheric re-entry. The Black Knight is a research tool for the Blue Streak—the de Havilland Propellers LRBM. Any use of the Black Knight as a satellite-launcher is dependent on the value of such a project as assessed by the Royal Society. This would obviously entail expenditure above the present budget and would also be a diversion from the essentially military nature of the programme.

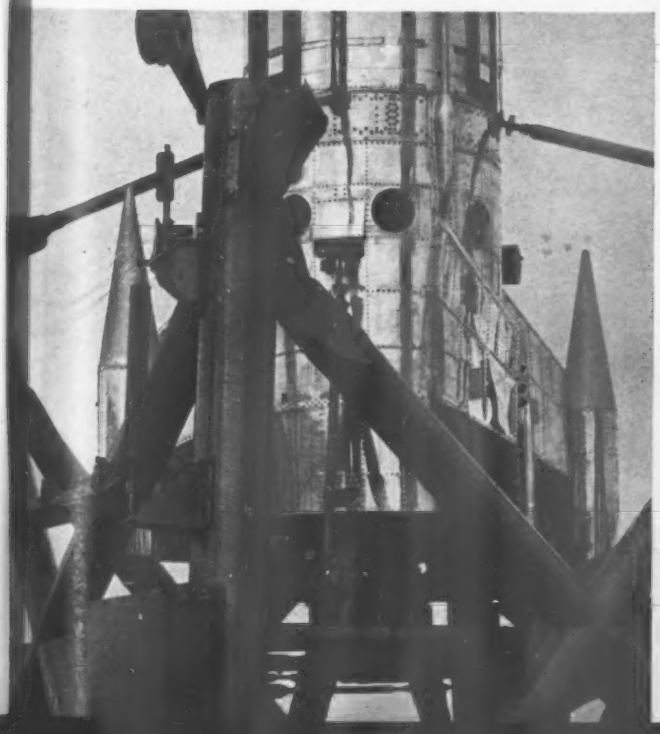
In view of the overall importance of this project, it is a pity that more was not made of this chance to show it in public when the opportunity arose. News that the launching at Woomera had been successful reached this country early in the afternoon of the last day of the S.B.A.C. Show. Yet, although a Black Knight was at Farnborough, it was not shown to the 110,000 spectators present. Only at the last moment were models put on to the stands of Saunders-Roe and the Ministry of Supply, but few people can have seen them. How much better it would have been for the Black Knight to have been put on the platform ready for it to be uncovered as a final note of triumph at the end of the week.

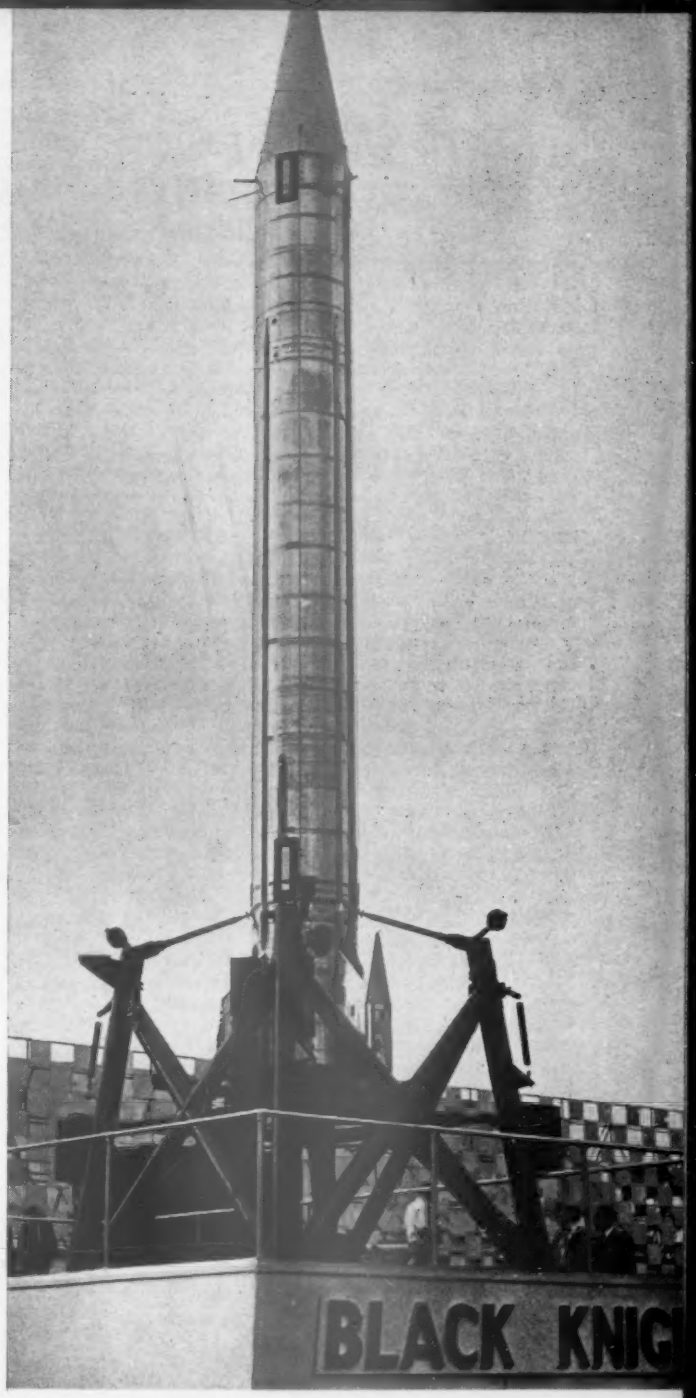
It seems that the Minister had decreed that no model should be shown before a successful launching had been made. This is understandable enough, but is not in line with the widespread practice of showing models of aircraft when at a very early project stage. Certainly, it would have been ill advised to invite the World's Press to attend the first launching, but there can be no valid argument against showing at least the shape of £5 million in terms of models of the Black Knight. At the very least, arrangements should have been made in advance to put up the full-size missile for display the moment news of the successful launching was received.—D.G.



SUCCESSFUL RE-ENTRANT.—The nose-cone of the Black Knight is apparently covered with a resin-bonded glass-fibre sheath to resist kinetic heating.

POWER HOUSE.—The main rocket engine and trimmer rockets are housed in the finned base of the missile. Two fins have flare canisters at their tips. The holes are for access while preparing for launching.





FARNBOROUGH POSTSCRIPT.—On the edge of the otherwise empty guided-weapons park at Farnborough, above, a Black Knight points proudly skyward. Below, a close-up of the base of the missile shows one of the four main rocket nozzles between two of the four small trimmer rockets.

Photographs copyright "The Aeroplane"

Air Transport

The Dollar Influence

NOT many people are aware of the extent of the World civil aviation assistance programmes which are in progress under American sponsorship and with American financial support. According to *Aviation Daily* the 1958 (fiscal year) programme involves a sum of nearly $10 million, with grants to more than 35 different countries—and the bulk of the expenditure involves U.S. equipment and, more important perhaps, U.S. ideas.

The majority of the countries involved are in Asia and South and Central America and the projects range from a $2,000 meteorological training programme in Turkey to an $800,000 programme for the installation of an air navigation system in Pakistan. The programmes include such work as that on air transport development by P.A.A. in Afghanistan, airline training in Ethiopia, where T.W.A. manages the national airline, and air navigation installation by Transocean in Persia.

All of which is excellent as a means of ensuring the spread of western philosophies and technical methods as opposed to those of the Soviet Union. But the programme is also bound to have a considerable influence on navigation-equipment choice and on air traffic control thinking in the future—and the American equipment and thinking are not necessarily the best for the future of world air transport.

Put in simplest terms, the free installation, for instance, of VOR or VORTAC equipment in the course of an assistance programme might put back for many years the prospect of the universal installation of another navigational aid, such as Decca, which might be to the greater overall advantage of air transport. The implementation of British A.T.C. policies might thus be limited to the installation of Dectra track-guide transmitters at focal points in the eastern hemisphere.

B.E.A. Fares Cut

DURING the winter months, from November 1 until next April, British European Airways is to introduce 8-day "week-end" excursion fares on the routes connecting London to Edinburgh, Glasgow, Belfast and Manchester. The new fares are slightly less than 60% of the existing 12-monthly return fares, and are available on any services operating on Saturdays or Sundays in either direction. Thus, the traveller using one of these excursion tickets can make his outward journey one week-end, and return the same week-end or the following one.

The excursion fare for Scotland and Northern Ireland is £8 (normally £13 10s.) and for Manchester £5 10s. (normally £9 9s.). No alteration will be made to the standard of seating or service on the Viscount 700s and 800s operating on these services in the present winter season, although B.E.A. is developing a 60-63 seat high-density arrangement for the V.701 for use on the domestic routes in the 1960s.

The introduction of these cheap winter fares is in keeping with B.E.A. policy outlined recently (see THE AEROPLANE for September 5), which is aimed at bringing about a general reduction of fare levels in Europe. B.E.A. does not expect to be in a position to implement this policy fully for another year or so; meanwhile even a temporary and limited reduction of the kind now announced will be welcome to the users of the domestic trunk routes.

Death-knell of the Differential?

ACCORDING to reports from Washington, the U.S. Civil Aeronautics Board has circulated to the airlines a statement expressing the view that turbojet transports should be able to operate at normal fares and that there should be no increase in present North Atlantic and Pacific rates.

This statement—preceding as it does by a fortnight or so the annual traffic conferences of the International Air Transport Association at Cannes—may well, if correctly reported, have a considerable influence on the progress of the discussions at this conference. Fare changes, like other decisions made by I.A.T.A., must be unanimously agreed, first within the Association and thereafter by the governments concerned, before they can be brought into force. If the U.S. government view is anti-differential, then there will be no unanimity—and no differentials; except possibly in specific areas such as Europe.

Meanwhile, Braniff Airways have, according to American reports, asked for a higher fare (15%) for their Boeing 707s to be used on both domestic and international operations in 1960, but the proposal has, for the time being, been rejected on technical grounds by the C.A.B.

Traffic Status Quo

THE figures for June this year show that there was a slight drop in the number of passengers handled by the airports in the London area when compared with the figures for the same month of 1957. The reduction is explained partly by the fact that Whitsun fell in May this year; in 1957 it fell in June.

The two monthly totals, which include transit passengers, were 432,227 for 1957 and 431,473 for 1958. The months' totals for all U.K. airports were 826,257 and 795,168 respectively, showing a drop of about 31,000. Air transport aircraft movements showed a marginal increase of about 1%.

On the brighter side, three airports showed really useful increases on the figures for last year—Southend (34%), Ferryfield (14%) and Manchester (7%). Evidently the independent operators, who are responsible for most of the traffic at Southend and all the traffic at Ferryfield, are not suffering from the general decline in traffic growth—a fact from which lessons can be learnt by those who wish to do so.

MOSCOW DEPARTURE.—A correspondent recently returned from Russia provides this new photograph of an Aeroflot Tu-104A at Vnukovo. After passengers had boarded, it was towed away by the truck on the left before the engines were started. Our correspondent reports that the Czech airline C.S.A. is getting most of the Moscow-Prague business, because of earlier departures and better cabin service.

Problems for the Trunk Routes

THE recent transfer of Nairobi's Flight Information Centre from Eastleigh Airport to new premises in the city is a reminder of the problems which have to be faced by the authorities on the main trunk routes now that turbojet aircraft are due to enter service.

The greater part of the thinking and worrying about the impact of the turbojets has been concerned so far with the heavy traffic areas of the World—but problems of an urgent, if different, kind must be met by those in charge of long-haul air traffic control.

Nairobi's F.I.C., now on the top floor of the new East Africa High Commission headquarters building in Nairobi, is responsible for an airspace with an area of some 1,500,000 sq. miles. Its traffic, at an average of little more than 3,000 flights a month, is minute when compared with that in much smaller airspaces in Europe or North America. It may be thought that air traffic services could be administered without difficulty; but there are problems even now, and those of the future will be more acute.

It is not always appreciated that staging posts on the World's main trunk routes handle new types of long-range airliner within days of their first scheduled service appearance in the terminal areas of London or New York. The Britannias, Super Constellations and DC-7s of today operate regularly through East Africa, while the route to South Africa will be among the first to be flown by the Boeing 707, the Vickers V.C.10, and the Douglas DC-8.

Current types of aircraft operation present no real en route separation problem. They are not critical as to level, and the chain of non-directional radio beacons, which is the backbone of the navigational system in Africa, permits enough position information for separation purposes. But the increasing speeds of these aircraft have begun to reveal weaknesses in both fixed and mobile communications. The transit time for fixed service aircraft movement messages is tied by agreement to a percentage of flight time at a nominal speed of 400 knots. The fixed service in East Africa can just satisfy this criterion, but the higher jet speeds will call for development. To this end a radio-teletypewriter circuit between Nairobi and Germiston is planned, while within East Africa acceleration will be achieved by a progressive change from manual radio-telegraphy to line teletypewriter circuits.

High-frequency radio-telephony, introduced as standard for en route communications in Africa several years ago, is a satisfactory medium in many parts of the World. In the tropics it is sometimes well below that level. The noise factor is often so great as to make a channel unusable and a listening watch can be an exhausting duty for aircrew and ground communicator. Selective calling devices are now coming to the fore and East Africa is about to experiment with one of them. Single sideband operation also promises some relief, and will be tried in due course; but the real future does seem to lie in a static-free form of communication, particularly when the coming jet requirement for direct pilot-to-controller communication is remembered.

East Africa planned a pilot VHF area-cover scheme several years ago. Installation is about to begin and, if results are good and funds can be found, the scheme will be extended to cover at least the north-south trunk routes through the territories. Three fully duplicated automatic VHF relay stations will be built on hill sites within 150 miles of Nairobi and are expected to provide cover within a radius of 350 miles of the city. In theory, stations on the peaks of Kilimanjaro and Mount Kenya would alone provide even greater coverage; but routine servicing and occasional repairs are sure commitments and the Directorate has not so far recruited alpinists to its technical staff—nor is there a ready source of power at those elevations.

The coming jet operations—with their critical requirements for continuous control in all weather conditions, accurate navigation on laterally separated tracks and unrestricted climb and descent—will strain the resources of states south of the Mediterranean. The years go by without a clear international decision on the types of aid required for medium- and long-range use; but, even if the final selection is, for example, an area-coverage type of aid, it is scarcely likely that countries with limited resources could install the latest and the best during the first years of jet operation.

The idea of navigating laterally separated tracks along a route served by a single chain of NDBs would appal most pilots and controllers, even though a complicated use of the position-line technique would make it possible; this is not practicable without a full-time navigator. The operators, who have perforce accepted jet aircraft designed with—at best—a limited regard for the realities of navigation south of the Equator, may perhaps be prepared to accept slightly

FIRST COMET 4.—This impressive air-to-air picture of the first production Comet 4—which is at Hong Kong as we go to press with this page—was taken over the Thames near Woolwich during a recent B.O.A.C. crew training flight. The Comet will eventually be one of the turbojet aircraft on the African trunk routes, some A.T.C. problems of which are discussed in the article above.

Photograph copyright "The Aeroplane"

uneconomical routeings to ease separation outside terminal areas.

Airways, which are not yet justified by traffic in Africa, may follow the introduction of jet aircraft on the trunk routes. The air traffic advisory service, which was conceived as the halfway house between full control and no control at all, has been criticized since its inception on the very ground that it is neither one thing nor the other and leaves both pilot and controller in a dangerous state of uncertainty.

If airways are, to any extent, to replace advisory routes in Africa an improvement in navigational services will be required. This improvement may be supplied, in part, by airborne navigational systems. High-level airways, available only to the new jet airliners fitted with self-contained navigational equipment, may prove to be the answer—supplemented in terminal areas by improved ground navigational aids for the control of climb and descent. To meet the latter commitment the East African authorities have been reviewing terminal-area radar equipment.

The new Centre in Nairobi has been set up with room for expansion in all its departments. Spectacular development is not the aim, but the East African Territories are sufficiently forward-looking to keep pace, as best they can, with the needs of modern air transport.

Five-year Subsidy for N.Y.A.

NEW YORK AIRWAYS, the inter-airport helicopter operator, will be the first such operator to receive a long-term government subsidy. During the next five years this subsidy will amount to $10,380,600 (about £3,700,000). The subsidy, with a payment of $2,309,355 (about £825,000) for the year starting July 1, 1958, was approved recently by the C.A.B.

N.Y.A. operates five 15-passenger Vertol helicopters linking Idlewild, La Guardia and Newark—New York City's major airports—and nearby towns. Robert L. Cummings, Jr., the company's president, made the following statement when the subsidy approval was announced:

"Now, for the first time in the history of local helicopter transportation, plans can be laid with a better knowledge of the future financial position of the line. With such planning possible, the next step in commercial helicopter aviation rests directly with the manufacturers of turbine helicopter engines. The present model of the Vertol helicopter is powered by a single piston engine. The ships can be converted into twin-turbine aircraft. . . . Turbine engines will very sharply increase . . . reliability and overall performance, as well as having a marked impact on operating expenses."

On August 23 N.Y.A. inaugurated helicopter sightseeing flights around New York City using a two-passenger Bell 47-H.

Canada's DC-3 Replacement?

SO many manufacturers have attempted to produce a DC-3 replacement in the past ten years—and so few have come anywhere near to success—that it is dangerous to categorize any new aeroplane in this class until it has proved itself. Nevertheless, in the Caribou, de Havilland Aircraft of Canada, Ltd., shows signs of having designed an aeroplane of DC-3 size which will be capable of great versatility of operation as a utility transport and will, moreover, have very much better field performance than the DC-3 ever had.

As already recorded in these pages, the Caribou made its first flight on July 30. This prototype is one of two ordered by the Canadian Government and is to be used for extensive evaluation trials. By February of next year, de Havilland expect to deliver the first of five Caribou ordered by the U.S. Army, and at the same time will start work on the first batch of 20 production aircraft. Target date for delivery of the first civil Caribou is March, 1959, with a price tag of $495,000.

Of interest to the civil operator is the spacious, square-section Caribou cabin; the ease of loading through the rear fuselage ramp; and the use of well-proven Pratt & Whitney R-2000 radial engines—the DC-4 powerplant. The engines will all be second-hand, but thoroughly reconditioned for the Caribou by Canadian Pratt & Whitney.

The S.T.O.L. characteristics—obtained conventionally enough by the use of full-span double-slotted flaps and leading-edge flaps—will also appeal for certain types of operation, particularly in remoter areas where paved runways are not available, or for operations into small airfields close to city centres. For operations from longer runways where maximum take-off performance is not demanded, the present gross weight of 24,000 lb. will be substantially increased in due course.

A detailed specification of the Caribou appeared in our Commercial Aircraft number on July 4, and additional photographs and information can be found in the issues of August 15, August 22, and September 12. A performance summary, at 24,000 lb. gross weight, follows:—

Take-off and landing, short field technique: Take-off ground run (max. t.o. power) 490 ft.; distance to 50 ft., 840 ft. Landing distance from 50 ft., 1,000 ft.; landing ground run, 425 ft. Climb, flaps at "take-off," 1,500 ft./min.; on one engine, 315 ft./min. Climb, flaps up, 1,830 ft./min.; on one engine, 460 ft./min.

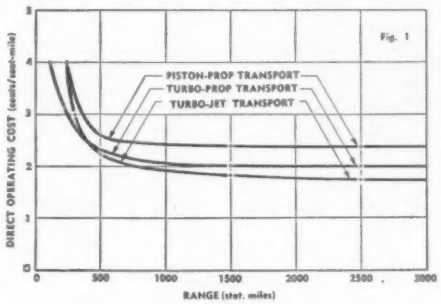
Take-off and landing, airline technique: Take-off ground run (unstick at 1.2 V_{S1}, max. t.o. power), 885 ft.; distance to 50 ft., 1,305 ft.; accelerate-stop distance, 2,080 ft.; required t.o. field length, C.A.R. 4b technique, 2,070 ft. Landing distance from 50 ft. (approach at 1.3 V_{SO}), 1,305 ft.; landing ground run, 565 ft.; required landing field length, C.A.R. 4b technique, 2,170 ft. En route climb at max. cont. power, both engines, 1,570 ft./min. at sea level, 1,560 ft./min. at 5,000 ft.; one engine, 315 ft./min. at sea level, 280 ft./min. at 5,000 ft.

Service ceiling, 24,900 ft.; one engine, 10,500 ft. Max. weak mixture cruising speed (62% max. cont. power) 148 knots T.A.S. at sea level, 159 knots at 7,500 ft. Stalling speed, 52 knots E.A.S. Maximum range 1,170 naut. miles. With 4,973 lb. payload (27 passengers) and 45 min. reserve fuel, a 520 naut. mile stage can be flown.

The distinctive lines of the Caribou are shown in these two photographs. Note, on the left, the hinged cowling for easy engine access. The design of the high-lift double slotted flaps along the trailing edge, based on experience with the Beaver and Otter, will not be finalized until early flight trials with this prototype have been concluded.

The Cricket on the Hearth

TO the sports-loving British visitor to the U.S.A. it comes as a pleasant surprise to find that cricket is still played on a modest scale in the Western World's richest republic—although Kipling's "flannelled fools at the wicket" may take a bit of finding. As a matter of fact the game happens to flourish around Los Angeles and a few Sundays ago we enjoyed the leisurely pleasure of watching a couple of Hollywood's mixed Anglo-American teams. And looking at the verdant pitch, we found ourself reflecting that not so long ago the sales-pitchmen



for the turboprop were batting on what looked like (to them) a velvet-lawn wicket. "We Believe in Turboprops" was boldly emblazoned on the club-house banner. The play, in fact, was going well for the home team, with the players well on the way to knocking up a four-century score—until a jet cricket was discovered, boring wickedly into the green carpet. Its chirping has grown louder, the wicket gets stickier, and the jet bowlers are finding the range.

Which undoubtedly accounts for those other chirpings now coming from the club-house, for the jet cricket has invaded the hearth and there is much twittering about the merits of a fare-differential between turboprop and turbojet airliners. Because the turboprop cruises some 120-150 m.p.h. slower than the jet, the impression has been fostered abroad that its operating cost is necessarily cheaper by some 10% or so over medium and long ranges. Only a short time ago the backroom boffins of B.E.A. said just that—and then proceeded, after long drawn out dickering and doodling, and about five years too late on the imagineering TIME scale, to order medium-range jets against the spur of foreign competition. It is all too obvious that Time, the fourth dimension, has not been juggled with the other three at the drawing board stage. "It (the B.E.A. jet) stemmed from necessity rather than desire," quoth a B.E.A. executive, looking wistfully back at the windmills—*laissez faire, laissez passer!* Such literary boomerangs are bound to return and bite the hand that tossed them.

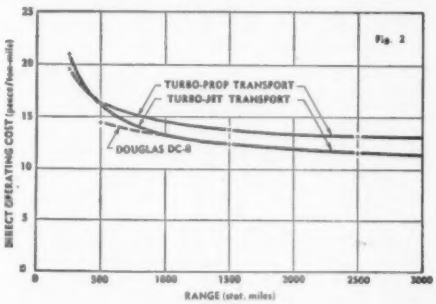
Boeing and Douglas jet costing, as might be expected, shows direct operating costs the other way round; that is, with the jet cheaper than the turboprop from 400 statute miles on up to the longest ranges of 5,000 s.m. or more. Below about 400 s.m. the turboprop, in the present state of the art, remains the cheaper to operate—for fairly obvious reasons of block speed and cruising height. Boeing-Douglas costing has been confirmed by recent independent "ivory tower" studies conducted by Cornell University (Fig. 1). Much the same qualitative order of things was predicted some years ago by de Havilland (Fig. 2). If we assume, however, that both sides in the Whittle *v.* Windmill argument are equally biased (or lacking in operational data), then we can settle, for the time being, that the comparative cost curves are broadly equal from 400 s.m. up. If this fair assumption be accepted, what price then a fare-differential in favour of the turboprop, seeing that it is technically inferior on all counts? Lower the fare for the medium- and long-range turboprop and one surely hastens its demise because of unprofitable operation. The poser here, perhaps, is how much of a fare cut would be necessary to push the passenger load factor of the turboprop high enough to cut into the appeal of the high-flying jet.

The plea for a fare-differential points up the increasingly obvious fact that the second generation of British, and first-generation American and Russian, turboprop airliners are badly off in their timing, even assuming that they ever had an economic place in the Jet Age that really began as far back as May, 1952, with the pioneering entry of the Comet 1. Even more unfortunate in late timing and retrogressive design concept is that the new generation of British jetliners is still well below the far horizon of the production line. Under the duress of foreign competition, the inherent rightness of the original British jet line is now being spoliated by a mess of poddage. Instead of regaining the vision splendid, as formerly envisaged in the near-immaculate aerodynamics of the Vickers V-1000, we are now "outstandingly" committed to the gingerbread school of pendant poddery. Barnacles, and big ones at that, must always carry a heavy drag penalty. They offend the mind as much as the eye.

Further, in order not to offend the ear too much, isolated jet pods are now sprouting some remarkably ugly-looking cabbage-like propulsive nozzles that are bound to penalize the net thrust output, despite the ardent denials of their perpetrators. The proper (and practical) solution, as we see it, is the submerged wing-root engine with flattened jet pipe and horizontal ribbon jet exhausting through a split-type trailing-edge flap—a scheme which was first suggested by Westinghouse Electric in the U.S.A. as far back as July, 1943! In addition to the substantial jet flap boost, especially useful at take-off, there is ample experimental evidence to confirm the efficacy of such a scheme in appreciably lowering the noise level without the aforesaid stuffed-pipe ironmongery and the weight and cost that accompany it.

As a jet-rider to all this chronic chronologics, we commend the Time philosophy of Mr. Hayne Constant, Director of the N.G.T.E., in his recent Royce Memorial Lecture, "Pyestock's Contribution to Propulsion," R.Ae.S. Journal, April, 1958:—

> "Right from the very beginning of our work there was one basic concept in our philosophy that conditioned our general thinking. This concept was the vital importance in engineering development of making a sufficiently concentrated effort



on a small front to keep ahead of all competitors. In a country such as ours in which the effort available is limited, this implies getting off the fence as quickly as possible and deciding definitely between alternative possibilities rather than giving a little backing to each. This is not an easy policy to adopt; hedging requires far less thought. It is a dangerous policy, because if you back the wrong horse you have nothing else to turn to; but if your judgment is good it gives great advantages.

"Up to the outbreak of war in September, 1939, we had been backing the axial type of turboprop as opposed to Whittle's advocacy of the centrifugal jet. We climbed down, or rather over the fence, and backed the jet because we thought it an easier job than the turboprop and one which might be carried through in time to affect the war. Having done this it was not long before we came to the conclusion that aircraft speeds were likely to continue rising in the future as they had done in the past and that therefore, sooner or later, the propeller would have to give way to the jet. And since in this country our resources were limited it would be better for us to take the final step right away, instead of first taking the intermediate and more difficult one of propeller propulsion. In spite of all that has happened in the intervening 15 years I still believe that to be true. I think that if more attention had been paid to the jet and less to the propeller we should not now be so worried about the future of our airliners."

To which this observer on the American scene would offer up a seven-fold Amen! As we stand on the threshold of the Jet Age—in which Britain might have been in the van instead of the guard's van—it is our candid opinion that, through straddling both sides of the turbine fence too long, our spurs have become rusty and our design philosophy rustic. To quote Fouchés celebrated remark: "It is more than a crime; it is a blunder."—S.H.E.

LUFTWAFFE LOSSES.—In the fortnight up to September 7, 1940, when the Luftwaffe was attacking sector stations, 378 raiders were destroyed for a loss of 277 R.A.F. aircraft. In the following two weeks, when London was the main target, 262 Luftwaffe aircraft were lost while the R.A.F. lost 144. In this picture the remains of a Heinkel He 111K bomber are seen on a southern beach.

COMMEMORATING THE BATTLE OF BRITAIN

EIGHTEEN years ago, in August and September of 1940, the under-equipped Royal Air Force, in the skies above the south coast of Britain, fought a series of engagements against the Luftwaffe which came to be known as the Battle of Britain. The event is commemorated this year, as it has been in the past, by Battle of Britain Week, and by an R.A.F. "At Home" day—on Saturday, September 20—when Service stations throughout the country will be open to the public.

The occasion has taken the place of what used to be known as Empire Air Day. It was in 1934 that the Air League of the British Empire, under its energetic secretary-general, Air Cdre. J. A. (now Sir Adrian) Chamier, promoted a scheme to create greater interest in aviation among the general public. The idea was that flying and the use of the air should be encouraged and popularized, and so accelerate the rate of air progress and development—in Britain and throughout the Empire.

Not only were Service stations thrown open but the Air League elicited the co-operation of civil authorities, with the result that activities at civil aerodromes, flying clubs and aircraft factories were also revealed to a much wider public.

The idea received a Royal blessing, and King George V and Queen Mary visited the R.A.F. station at Bircham Newton, close to Sandringham. At the military bases such aircraft as Heyfords, Sidestrands, Harts, Bulldogs and Furies were exhibited, on the ground and in the air; at civil aerodromes—Croydon, Heston, Hanworth and numerous others—contemporary types of commercial and club-flying aircraft were to be seen.

Biggin Hill had as many visitors as most aerodromes, some 5,540 people attending, and this station—in view of the significant part it played during the famous Battle—has ever since been one of the most popular. Last year some 220,000 people went there.

Empire Air Day was held every year up to the outbreak of war. The first occasion, held on May 24, 1934, was literally Empire Day, and fell on a Thursday; thereafter the nearest Saturday was adopted to allow a greater public attendance. The change was a good one, and the R.A.F. Benevolent Fund has accordingly benefited considerably from receipts.

After the War the function was revived, and in 1945—on September 15—the first Battle of Britain Day was held, marking the fifth anniversary of the R.A.F.'s victory over the Luftwaffe.

Since then the Battle has been commemorated in a similar manner, with a fly-past of aircraft over London (last year sadly reduced to a Hurricane, a Spitfire and a Javelin) and by static exhibitions of captured German aircraft and contemporary R.A.F. types on Horse Guards Parade, in London.

As noted in last week's issue, 34 R.A.F. stations are to be open to the public this year. Nearly 500 aircraft will take part in the various programmes arranged, including a certain amount of exchange flying between stations. More than a million people attended the stations last year.

Among the displays will be aerobatics by Nos. 111 and 56 Squadrons, the Central Flying School, and No. 229 Operational Conversion Unit; the three types of V-bomber will perform along with most other Service types. The four Super Sabres of the Skyblazers team of the U.S.A.F. will be at Biggin Hill and Horsham St. Faith.

In London a commemorative service will be held in St. Paul's Cathedral at 15.15 hrs. on Sunday, September 21, coincident with which will be a fly-past by a Hurricane, a Spitfire and nine Javelins.

PRE-SCRAMBLE ACTION.—Quick refuelling and ammunition replenishment were keynotes to the successful interception of raiding formations. Hawker Hurricanes are here seen awaiting a "scramble" from Fighter Command operations room as their pilots stand by. By skilful use of radar the R.A.F.'s limited defending forces were sent to the right place at the right time.

Completing the Trio

WITH the recent entry of the Handley Page Victor B.1 into squadron service with Bomber Command, the V-bomber trio—Vickers Valiant, Avro Vulcan and the Victor—is now complete. Designed to the same specification as the Vulcan, the Victor has been in operation with No. 10 Squadron of No. 3 Group at R.A.F. Cottesmore since April of this year. A second squadron—No. 15—is in the process of being formed at Cottesmore, and the Victor is also flying on crew-conversion training at No. 232 Operational Conversion Unit, R.A.F. Gaydon.

In addition, a photographic-reconnaissance version is in service with the Command's P.R. units at R.A.F. Wyton, where Valiant B(PR)K.1 and Canberra PR.7 squadrons have been operating for a number of years. Forming part of the United Kingdom's Reconnaissance Force, the work of these squadrons was described in THE AEROPLANE of May 16, 1958 (pages 684-687).

Responsible for the Valiant and Victor units in Bomber Command, No. 3 Group is under the command of Air Vice-Marshal K. B. B. Cross, C.B., C.B.E., D.S.O., D.F.C. R.A.F. Cottesmore is commanded by Gp. Capt. J. E. "Johnnie" Johnson, D.S.O., D.F.C., and the C.O. of No. 10 Squadron is Wg. Cdr. C. Owen, D.S.O., D.F.C., A.F.C. No. 15 Squadron is commanded by Wg. Cdr. D. Green, D.S.O., O.B.E., D.F.C.

First formed from No. 1 Reserve Squadron at Farnborough on January 1, 1915, No. 10 Squadron has, with the Victor, been equipped with five different types of Handley Page aircraft, including the Hyderabad in 1928, the Hinaidi in 1930 and, later, the Heyford. In 1945 the Squadron was transferred to Transport Command and took part in the Berlin Airlift before being disbanded in February, 1950. Reformed at R.A.F. Scampton with Canberras in 1953, it was transferred to No. 3 Group in April, 1955. The same year it won the War Armament Officer's Trophy—the premier prize in the annual bombing competition.

On October 21 next the Squadron is to be presented with its Standard by H.R.H. Princess Margaret.

The Victor B.1 now in service is powered by four Armstrong Siddeley Sapphire 200-series (A.S.Sa.7) turbojets; the later Mk. 2 is being fitted with the Rolls-Royce Conway R.Co.11 by-pass engine, for which a thrust of 17,250 lb. has been announced. A constant-thrust version of the de Havilland Spectre rocket motor is to be used with the Victor so that it can operate from existing medium-length runways at high take-off weights. One Spectre D.Spe.4 will be fitted under each wing, installed as a self-contained unit in a releasable nacelle which is dropped after firing. The nacelle is fitted with parachute gear so that the engine can be recovered for repeated use.

Flight-deck Accommodation

A Victor crew is standard with the other two V-bombers—captain, co-pilot, navigator/plotter, navigator/radar operator and air electronics officer (A.E.O.). The crew chief will also fly with his aircraft on overseas flights in the normal way, but this seat has not yet been fitted.

Unlike the Valiant and the Vulcan, where the captain and co-pilot are seated on a platform well above the level of the main cabin floor—which gives the impression of two compartments—the crew of the Victor are almost on the same level. The two pilots are slightly lower than the three backward-facing members. From the entrance hatch on the port side, also known in Bomber Command as the "pilots' entry and crew exit door," the operating position order is A.E.O., navigator/plotter and navigator/radar operator on the far side. The sixth seat for the crew chief will be behind the two pilots' ejection seats.

Cabin pressurization is normally maintained at combat differential as opposed to cruise pressure for training purposes, so that cabin altitude requires oxygen masks to be worn for most flights. The cabin is equipped with small electric elements on which the crew can heat their tins of soup that now form part of flying rations, but until the new oxygen masks fitted with a polythene tube for drinking are introduced the soup has to be taken between gulps of oxygen from the mask.

Considered to have the best all-round view of the three V-bombers, the Victor also has the largest flight deck. Fitted with twin blind-flying panels and centrally mounted engine dials and gauges, the pilots' instrument panel also contains a central fuel control panel, including air-to-air refuelling equipment, which slides horizontally forward so that when required the bomb aimer can get down and forward to his visual bombing position in the nose.

The ejection seats are Martin-Baker Mk. 3s; for normal emergency escape the rest of the crew would use the door. In the case of ditching, however, the captain has to jettison the canopy and escape through the roof hatch first to make way for the rest of the crew to follow him.

Little can be released on the performance and operational use of the bomber, but the half loop and roll-off-the-top manœuvres demonstrated at the recent S.B.A.C. Show for "toss bombing" are not thought by the Service to have much practical application at present in strategical operations. Apart from the fact that the aircraft used for the Show were flown lighter than fully equipped squadron aircraft, it was suggested that such a manœuvre would not give enough time or distance for escape from a large nuclear explosion.

Against present-day fighters Victor crews feel that they have a reasonable chance of getting to and from their target in the event of a war. The effectiveness and life of the V-bombers is increased by the development of the stand-off bomb. It has been stated that at its operational height the Victor can outfly and out-manœuvre any R.A.F. fighter at present in squadron service.

When a Victor inadvertently exceeded M=1 earlier this year it was during a delivery flight from Radlett to No. 232 O.C.U. at Gaydon.

Capable of operating at a higher ceiling with a better performance than the Valiants, Victors will slowly supplement the earlier bomber in a number of rôles. The Valiants are to be converted into tankers for air-to-air refuelling. The Victors at Cottesmore have not yet been fitted with probes, and No. 10 Squadron has to date not undertaken any training in flight-refuelling operations. Compared with the B-52s of the U.S.A.F., the Victor is faster, but being a smaller aircraft has less range.

First of the proper overseas flights to be undertaken with the Victors (although a number of round trips to Malta and landings in 2nd T.A.F. have been made) is planned for next month when Air Vice-Marshal Cross flies to the United States for the Strategic Air Command's bombing competition.

The crack discovered last month by Handley Pages in an internal member of a Victor's tailplane during a routine inspection has been described as corrosion stress. The cause was traced to an over-tightening in the assembling of the tail and a modification to revise this method of assembly is being introduced on all aircraft.

R.A.F. Cottesmore

Since 1948 Cottesmore has been used by two flying training schools and in March, 1954, three Canberra squadrons—Nos. 15, 57 and 44—were posted in. These remained until February, 1955, when the station was inactive operationally, being placed on a care and maintenance basis. It reopened early in 1957.

It now has one 9,000-ft. by 200-ft. runway, a new control tower and an electronics centre in addition to the normal maintenance facilities. The Victor has a 46-ft.-diameter braking parachute which is normally used on all landings. This reduces the landing run from 6,000 ft. to 3,000 ft.

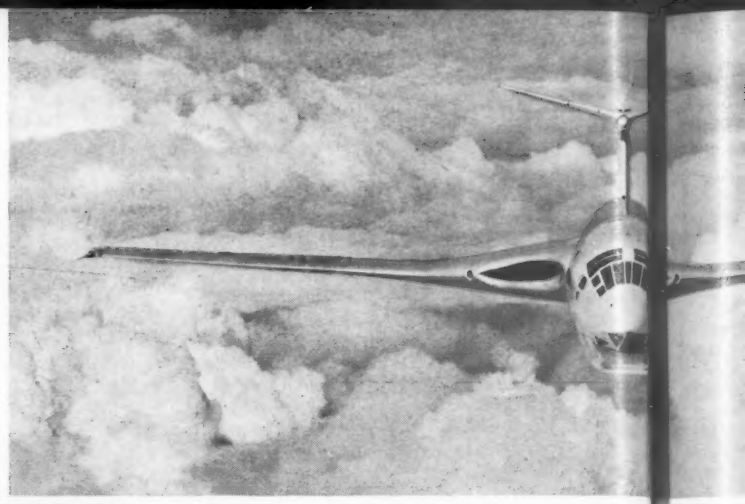
Still in the process of being installed, air traffic and approach equipment in the tower will consist of CR/DF; A.C.R. 7D control radar; precision aproach radar and C.P.N.18 long-range radar. At the present time the aids in operation are a mobile CR/DF and A.C.R.7D, which is used in conjunction with the long-range radar at R.A.F. Wittering.

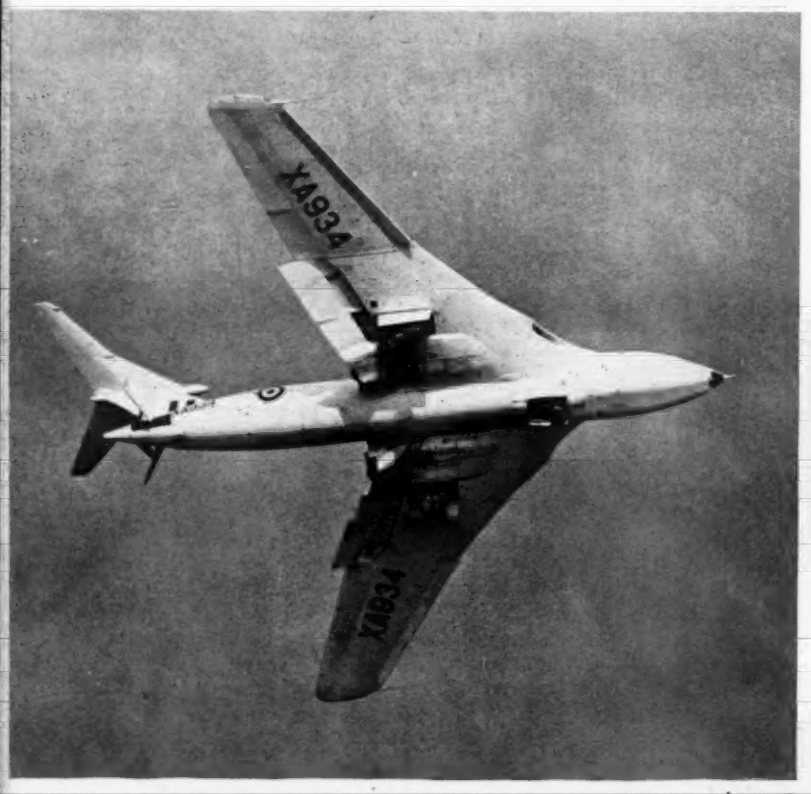
Forming part of the Technical Wing, the electronics centre is designed for second-line servicing and consists of five major sections. These are the communications bay where HF, VHF, ILS and radio compass components are serviced; a radar bay for GEE and radar altimeter; an airborne-radar bay containing Doppler and M.B.S. equipment, an instrument-calibration and test room for testing the bomb sight, blind-flying instruments, G.P.I. and G4B compass, and an electronics stores group. The two radar bays and the instrument room are all air-conditioned.

All Victor crews have been trained by the O.C.U. at Gaydon, where more than 1,000 hr. of intensive flying trials have been completed under the Chief Instructor, Wg. Cdr. D. Iveson, D.S.O., D.F.C. There are more crews than Victors in the Squadron and competition for a place is very keen, with the A.O.C., Air Vice-Marshal Cross, personally interviewing all crews.

To obtain a higher operational standard and more "professionalism" in the V-Force both air- and ground-crews are staying with a particular type for a longer period and a posting lasting five years is now the general practice. "Captaincy" is the problem with aircrew as opposed to flying ability and the emphasis is on individual crew training. Ground-crew in the technical trades are now long-term personnel and have been described as 90% tradesmen and 10% soldiers.—P.R.R.

As recorded on the previous page, the Handley Page Victor is now in squadron service; here some of the R.A.F.'s Victor V-bombers are seen on the ground and in the air at Cottesmore, home of No. 10 Squadron. Below, one of the Squadron machines flies over the aerodrome with wheels, flaps and wing leading-edge flaps down, and airbrakes extended.





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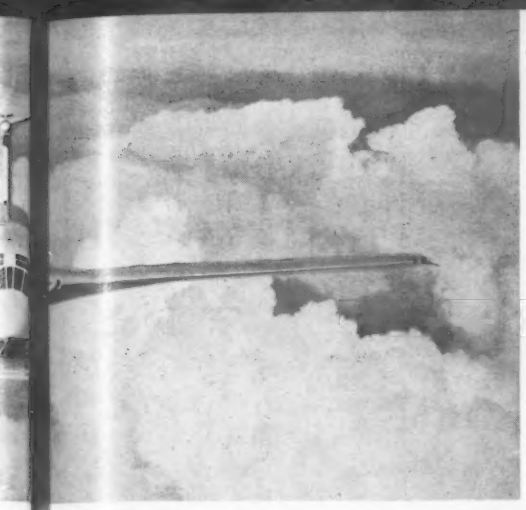

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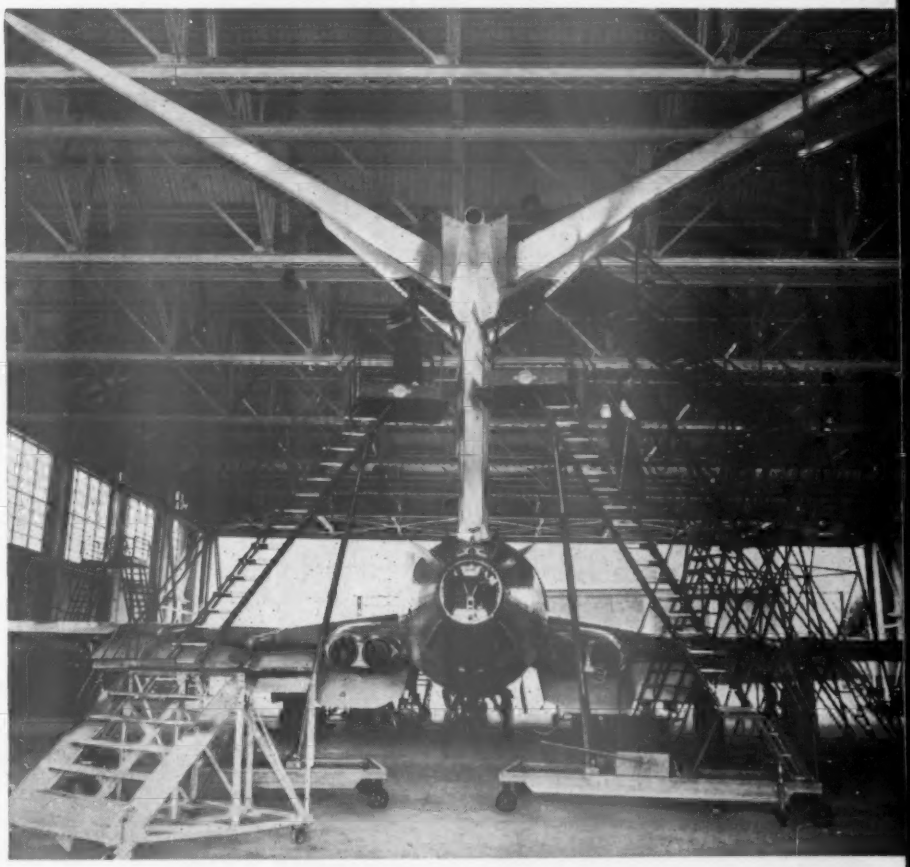
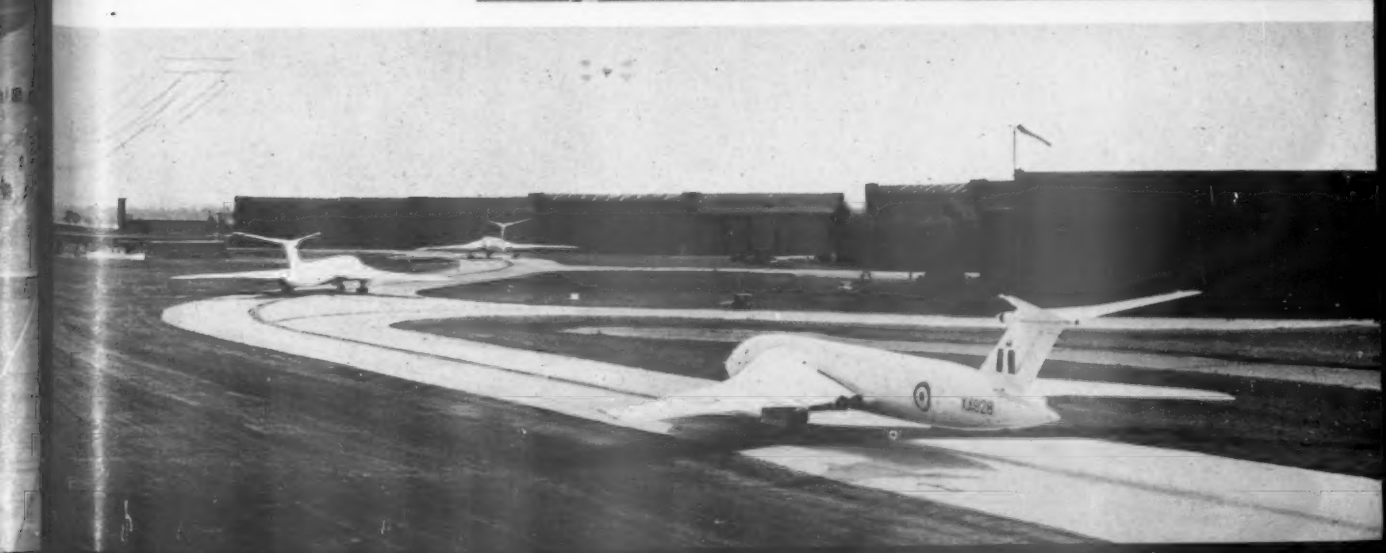
Photographs copyright "The Aeroplane"



Left, servicing the elevator and rudder electro-hydraulic power control units in the high set T-tail.

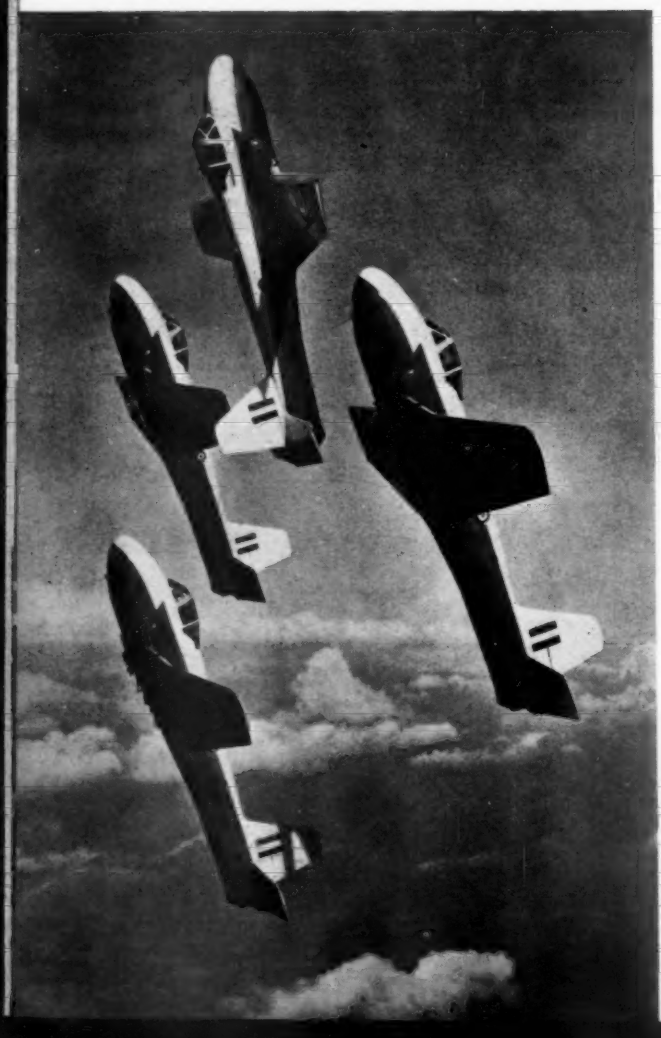
Right, in this unusual view the braking parachute stowage compartment can be seen at the base of the fin.

Below left, Victor B.1s of No. 10 Squadron lined up at Cottesmore, and, below, taxi-ing round the perimeter track.



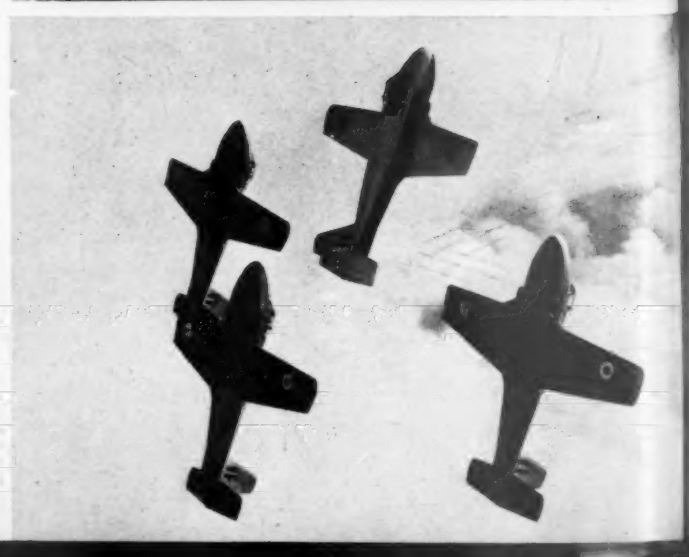
THE AEROPLANE
SEPT 19, 1958

Precision Flying by C.F.S.



A long-standing C.F.S. speciality—formation aerobatics with the leader inverted—has been continued by the Jet Provost team which performed so ably at the S.B.A.C. Display. Recently the team demonstrated this for our photographer and these exclusive pictures show that C.F.S. instructors are as skilled as ever in precision flying. The aircraft are flown by (left to right, below) Flt. Lts. N. H. Giffin (leader), D. McClen, F. W. J. Packer, and D. Millington.

Photographs copyright "The Aeroplane"



The Fighting Services

Senior R.A.F. Appointment

THE appointment of Gp. Capt. Anthony G. Powell, A.M.I.E.E., as Senior Air Staff Officer, No. 90 (Signals) Group, at Medmenham, Bucks, with the acting rank of Air Commodore, has been announced.

Since June, 1955, he has served as Chief of the Electronics Branch, Signals Division, SHAPE. He passed out from the R.A.F. College, Cranwell, in December, 1932, and flew army co-operation squadrons at home and in the Middle East. Subsequently he served in the Middle East on maintenance and signal duties, transfering to the Technical Branch in April, 1940.

For two years he was Deputy Director of Telecommunications, and joined the R.A.F. Delegation in the U.S.A. as Deputy Director of Signals. He also commanded two signals Wings and the Northern Signals Area. For two years he was Deputy Chief Signals Officer, H.Q., M.E.A.F., and on returning home became Deputy Director of Signals (Plans) in June, 1952, thereafter joining SHAPE.

Move to Malaya

ONE of the most important peacetime movements of aircraft in the history of the R.A.A.F. will begin in November next, when No. 78 Fighter Wing starts to transfer its Avon Sabres from Williamtown, N.S.W., to Butterworth in Malaya. The fighters belong to Nos. 3 and 77 Squadrons, which are going to Butterworth as part of the R.A.A.F. commitment to the Strategic Reserve in Malaya.

The move will be in two sections with the Sabres flying in formations of four. Approximately 20 aircraft of No. 3 Squadron will be flown to Butterworth in November, and No. 77 Squadron's aircraft will be transferred early in the New Year. The 6,000-mile route, which has already been surveyed by R.A.A.F. Dakotas, will be through New Guinea, the Philippines and Borneo.

To provide navigational assistance and secure advance weather forecasts for the Sabre flights, No. 6 Bomber Squadron at Amberley, Queensland, will operate its Canberras along the route. Neptunes from No. 11 Maritime Reconnaissance Squadron at Richmond, N.S.W., will provide air/sea rescue facilities along the eastern half of the route. In addition to these R.A.A.F. squadrons, the U.S.A.F. in the Philippines, the R.A.F. in the Borneo area, and No. 2 Bomber Squadron, R.A.A.F., at Butterworth, will operate the rescue and navigational facilities for the western half of the route.

No. 2 Airfield Construction Squadron, R.A.A.F., has been at Butterworth for several years now, modernizing the station for its new rôle, and No. 2 Squadron, equipped with Canberras, moved there from Amberley last July. An R.A.A.F. mobile radar control and reporting unit, a base squadron and other ground support units are already stationed at Butterworth, which is under the command of Air Cdre. K. R. J. Parsons, D.S.O., D.F.C., A.F.C., R.A.A.F.

R.A.F. Missile Training

THREE types of courses are now being operated by the R.A.F. for instructing General Duties branch officers in the design, construction and employment of guided weapons. These courses are being conducted at the R.A.F. Technical College, Henlow, and the R.A.F. Flying College, Manby.

The first two are introductory courses at Manby; one is a two-weeks' course on guided missiles and their guidance systems and the other a three-weeks' course to provide selected officers with a basic knowledge of ballistic missiles. The third is a 23-week course to give selected officers theoretical and operational knowledge of guided missiles and their guidance systems. The syllabus is divided into two parts consisting of 12 weeks' theoretical instruction at Henlow, followed by 11 weeks' training on operational aspects at Manby.

In addition, introductory courses on guided weapons are held at Manby for students of the R.A.F. Flying College. Plans are also being made to set up two specialized schools to provide for future operational training. One is to provide the instruction of surface-to-air guided weapons (SAGW) wings and the other is to give similar training to personnel in the intermediate-range ballistic missile (IRBM) squadrons. The SAGW wings are to be incorporated in the United Kingdom defence system, and the IRBM squadrons are being set-up in Bomber Command.

R.A.A.F. IN MALAYA.—This group includes (centre), Air Vice-Marshal V. E. Hancock, C.B.E., D.F.C., R.A.A.F., A.O.C., R.A.F. Malaya, who is on loan to the R.A.F., at Butterworth. The station is now an R.A.A.F. base commanded by Air Cdre. K. R. J. Parsons, D.S.O., D.F.C., A.F.C. (right). On the left is Wg. Cdr. C. Steley, commanding officer of No. 2 Squadron; next to him, Flt. Lt. H. Hurley, the Squadron's navigation leader.

The R.A.F. and Gliding Aerobatics

ROYAL AIR FORCE entrants in the National Aerobatic Gliding Contest to be held at Dunstable on September 21 will all fly an EoN Olympia 419 sailplane. They include Wg. Cdr. N. W. Kearon, of Bomber Command, who is deputy chairman of the R.A.F. Gliding and Soaring Association; Flt. Lt. B. B. Sharman, of R.A.F. Andover, and Sgt. A. Gough, who won this year's R.A.F.S.G.A. championship and who is now with 2nd T.A.F. in Germany. Details of the contest are in Gliding Notes in this issue.

The R.A.F. is now building up a strong team of sailplane pilots to be entered in next year's British National Gliding Championships.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Group Captains: B. S. Cartmel, O.B.E., to Air Ministry for duty in the Department of the Air Member for Supply and Organization; K. H. Gooding, O.B.E., to Headquarters, Bomber Command, for Administrative Staff Duties; P. P. Hanks, D.S.O., D.F.C., A.F.C., to R.A.F. Patrington to Command; H. P. R. Smith, to be President, Central Medical Board, and Adviser in Aviation Physiology, Central Medical Establishment, London; D. W. I. Thomas, R.A.F. Hospital, Wegberg, to Command.

Wing Commanders: R. Bradshaw, O.B.E., to Headquarters, Bomber Command, for Administrative Staff Duties; J. M. Ferguson, to R.A.F. Bahrein, as Senior Medical Officer; R. O. M. Jones, to Headquarters, Home Command, for medical staff duties; W. R. J. Marriott, to Headquarters, No. 23 Group, for Technical Staff Duties; P. G. H. Matthews, D.F.C., to R.A.F. Waddington for Administrative Duties; R. Seidelin to R.A.F. Hospital, Nocton Hall, to be in charge of the Medical Division; D. F. S. Shaw, to R.A.F. Halton as Senior Medical Officer; A. G. Sollis to R.A.F. Waterbeach for Technical Duties.

Reunions

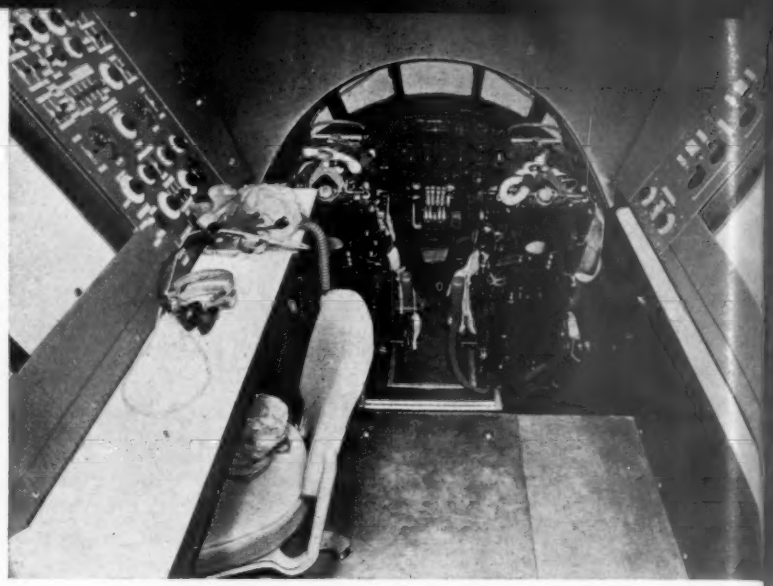
No. 208 Squadron.—Old Comrades Association annual reunion will be held at the Swiss Hotel, 53 Old Compton Street, London, W.1, on Saturday, October 25. For tickets, apply as soon as possible to the Hon. Secretary, Mr. R. W. Booker, 28 Great Road, Lancing, Sussex.

Aberdeen U.A.S.—The annual dinner will be held in the Caledonian Hotel, Aberdeen, on Friday, November 8, 1958. All past and present officers and members who are interested in attending are asked to write, as soon as possible, to the secretary, Aberdeen U.A.S., Powis Gardens, Bedford Road, Aberdeen.

The Vulcan Flight Simulator

by

Kenneth H. Simpkin, A.M.I.E.E., A.M.Brit.I.R.E.*



View of the flight deck from the instructor's control room which houses two console map recorders. These consoles also contain the controls for emergency flight and other conditions which can be simulated by the instructor.

THE modern V-bomber, as is its counterpart in civil use, is a complex machine. The trend towards specialized pilot training coupled with the need to operate the aircraft to the limits of its capabilities have inevitably resulted in longer training schedules. This fact, associated with the ever-present difficulty of training crews for new aircraft, which are rarely available in sufficient numbers to be plentiful at training establishments, has led both the R.A.F and the civilian operator to look to the flight simulator as a solution to the problem.

Flight simulators have been ordered by the Ministry of Supply for all three V-bombers, but this article is concerned with one, the Vulcan flight simulator which is now in service with the R.A.F. at Waddington, Lincs.

The Vulcan simulator, designed and built by Air Trainers Link, Ltd., of Aylesbury, England, operates on the DC analogue computer principle similar to that recently designed by the company for the B.E.A. Viscount and Elizabethan flight simulators. Modern techniques have, however, so reduced the size of the equipment that this is believed to be the smallest and most compact flight simulator of its kind in the world.

General Description

Apart from air conditioning and supply generators, the Vulcan flight simulator stands a complete unit, inclusive of fuselage, on a base plinth measuring 26 ft. by 11 ft. and is 9 ft. 8 in. high.

The fuselage, which is a replica of that part of a Vulcan cockpit forward of the entrance steps, is positioned low down at the forward end and is completely enclosed above the canopy by a light-tight hood, in which powerful lamps are placed. The light intensity is controlled from the instructor's desk to simulate conditions ranging from heavy cloud at night to brilliant sunshine.

Aft of the fuselage, and set with a floor level some 14 in. higher, is the control centre of the flight simulator; this takes the form of a small room from which the instructor controls operations. The front end of the room opens into the cockpit in such a way that the instructor has a clear view of the instruments between the heads of the two pilots.

The two sides of the room are formed by two console map recorders which trace the ground position of the simulated aircraft simultaneously on two maps, one showing the complete area of operation and the other indicating the local area around the aircraft in greater detail. These consoles also carry the controls whereby the instructor is able to initiate emergency flight conditions and to set up conditions of atmosphere, weight, fuel, etc., on the aircraft, prior to take-off, or during flight. The rear of the room is provided with a sliding door and the whole is covered by an arched roof.

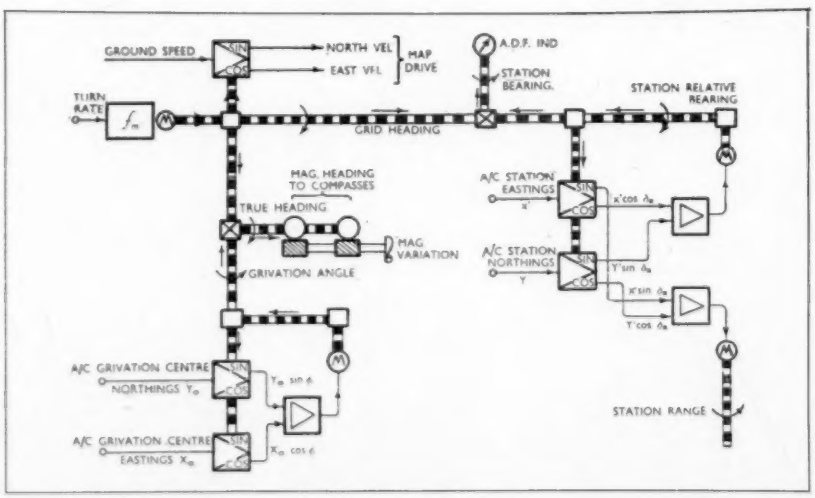
The instructor is, therefore, under the same lighting conditions as the crew, but is provided with controllable flood lighting over his consoles, which cannot be seen from the flight deck. This novel form of lighting has proved very realistic in operation.

An entrance platform is built aft of the instructor's room and at the rear, at a lower level, stand the computing racks. These comprise two double racks of equipment only; the port side carries the flight and flight instrument computer, and the high-tension regulated DC power supplies, and power supply control regulating circuitry; the starboard side consists of one rack simulating four Olympus engines together with their associated instruments, and a second rack for the various computers simulating the aircraft ancillary systems such as hydraulics, fuel system and cabin pressurization.

The floor of the fuselage and instructor's control room is a rigid box frame which carries the equipment simulating the flight loads on the flying controls and the auto-pilot, both of which are substantially identical to those used in the real aircraft. A ducted air-conditioning system, built integrally into the fuselage and instructor's room, is fed by sub-floor ducting from an external plant, designed and built by the Brightside Engineering and Foundry Co., Ltd., which maintains the crew's and instructor's quarters at a steady 70° F. with constant humidity. In the R.A.F. installation, the room housing the simulator is also force-ventilated to keep out dirt particles and to carry off the 8 kW. of heat generated by the computer racks at the rear.

The equipment has been designed with accessibility for maintenance particularly in mind. Removal of push-on covers gives immediate access to the rear of equipment in the fuselage, consoles and the plinth, in order to minimize the necessity of working from within the flight simulator.

* Project manager, Air Trainers Link, Ltd.



Vulcan heading and radio bearing computer diagram.

The computing racks are specially designed for maximum access, even while the equipment is in operation. The front of the rack houses amplifier units, computing networks and small rotary servos, all of which are self-connecting by plugs and location studs at the rear and can be withdrawn at will for inspection or maintenance.

The rear of the rack is formed into a door carrying strip-card potentiometer servos of special design which carry up to 30 potentiometers and are used to generate the non-linear functions necessary to the flight and engine computers. The door may be opened while the equipment is working, giving access to all wiring and test points both at the rear of the plug-in units and on the servo door. Rotary electro-mechanical actuators are also used, built on precision standard parts and incorporating involute-cut gears and high-precision potentiometers.

The strip-card potentiometers are of a special design, manufactured by Air Trainers Link, Ltd., and have an inherent linearity of better than 0.1%. They are used both in linear form and are also tapped and loaded by resistors to generate non-linear function laws. All amplifiers used are of similar mechanical construction and over 90% of those used are of one standard type, comprising two high-gain low-drift DC amplifiers built into one standard unit. Provision is made to drift-correct

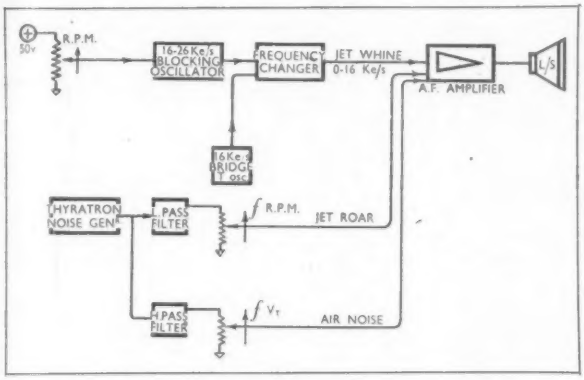


Diagram showing the circuit for engine and air noise simulation.

these further where required, which amounts to about 10% of the total.

Interconnection of signals between racks is carried out on a central distribution board located in the starboard console, connection being made by plugged cables so that assembly and breakdown is relatively simple. Thus the equipment may be transported in small units.

Operation of the equipment differs little from the aeroplane. The instructor is provided at the console with controls which enable him to pre-determine the atmosphere in which the aircraft will fly, its fuel, take-off weight and centre of gravity position. In flight, these are automatically adjusted as the fuel is used or loads are disposed of.

Starting of the engines follows the standard procedure and a characteristic jet whine fills the cabin as each engine runs up to ground idling revs. Taxi-ing is carried out on the compass and as the throttles are opened for take-off, the engine noise deepens to a roar and the take-off commences.

Handling is similar in all respects to that of the aircraft itself, great care having been taken in the design to simulate accurately the transient handling characteristics both at high speeds and on the approach, as well as the steady state performance of the aircraft in climbs, level flight and descents. An indication of the accuracies met may be judged from the typical examples of engine thrust, which for given r.p.m., height and speed, is within 2% of the information received on the aircraft over the whole range of operation.

Flight and Engine Computer

The achievement of these accuracies is largely in the adoption of one or two basic underlying principles. Whenever possible, a time analogue of the physical phenomena being simulated is set up. The flight computer is a wind axis analogue computer solving Newtonian mechanics, the only departure from analogue being the extent to which the functions defining the variation of aerodynamic coefficients are faired off.

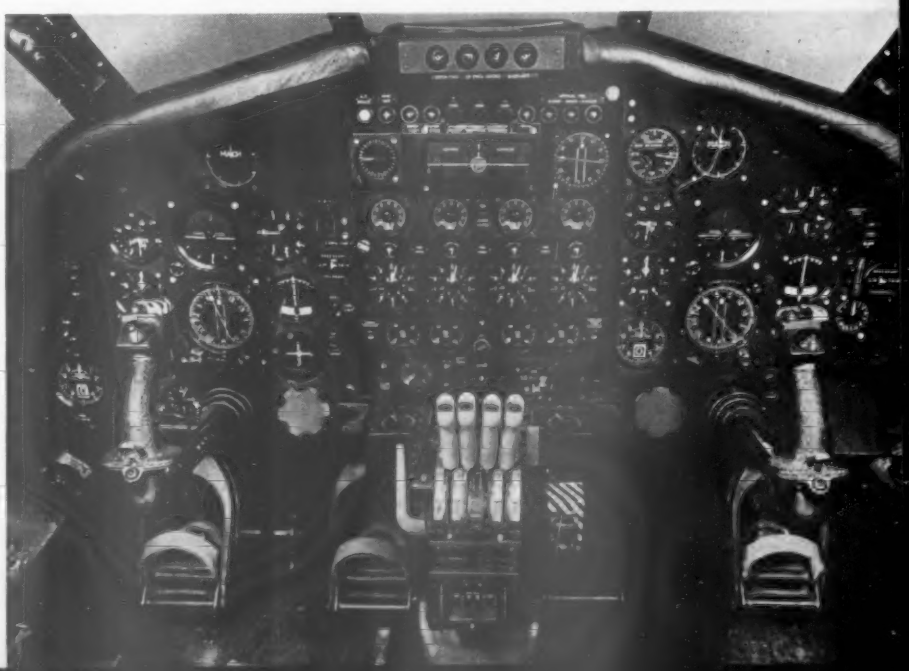
The engine computer is analogued so far as is possible although the problem of analoguing a two-spool gas-coupled turbojet engine over the whole of its régime is difficult. The operation of the engine is set up as a complex potentiometer servo network representing the continuous solution of r.p.m., fuel flow, jet pipe temperature, and thrust as functions of height, speed and engine throttle opening, presented in graphical form.

The problem of air to ground transference and vice versa, a difficult one on flight simulators, is attacked in analogue form, the moments and forces produced by the ground on the aircraft via the wheel contact gradually increasing as the weight supported by the wheels increases and the speed falls. The change over from aerodynamics to ground forces is thus made smooth and realistic, although departure from analogue is necessary in the interests of simplicity when side forces are present on the wheels or the speed falls to zero.

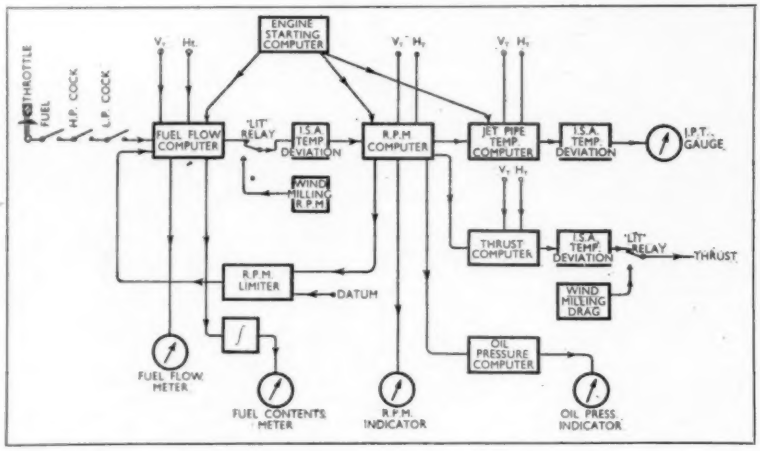
Radio-Navigational Aids Computer

Considerable effort has been expended in producing accuracy and high resolution in the presentation of aircraft ground position on the maps. The main recorder is provided with a 1 : 2,000,000 map measuring 42 in. by 30 in. This is driven directly by the velodyne motors which integrate the aircraft grid velocities, north and east, in order to remove the lack of resolution associated with a positional follow-up drive. The velocity integrators not only drive the pen across the map but are also capable of storing the position of the aircraft for over 1,000 n.m. outside the map area, the position being continuously recorded as a grid fix on Veeder-type counters.

The method by which map distortion associated with a Lamberts conical orthomorphic projection with two standard parallels is simulated, is of interest. The map drive itself



Cockpit layout of the Vulcan flight simulator. The light intensity in the cockpit can be controlled to simulate conditions ranging from bright sunshine to heavy cloud at night.



Layout of the Bristol Olympus B.Ol.1 simulator used in the Air Trainers Link Vulcan flight simulator.

operates on a flat-Earth principle, that is to say that easting velocity of the aircraft will drive the pen across the map parallel to the base edge. On the actual map, a line of latitude is represented not as a parallel east-west line but as a curve, whose radius of curvature increases towards the pole.

In the simulator, the pole is treated as a radio station, sited at the convergence point of the lines of longitude through the standard parallels, which provides a bearing to the pilot's compass. As the aircraft moves along a line of latitude, the compass is slowly deflected in such a way that although he is apparently flying on east-west course, the pilot actually traces the curve of latitude on the map. The deflection involved is very small, being of the order of 10° per hour in practice and the success of the method depends on whether the resolution of the recorder system as a whole can follow such small changes from an east-west course. In this equipment, the main recorder has been shown to be capable of smoothly drawing a circle of 11 ft. radius.

Radio compass and automatic approach facilities are built into the equipment. The accuracy of bearing on the radio compass is limited mainly by the instrument, which is teletorque driven, and the accuracy is of the order of 2° or better.

The ILS approach aid can be set up anywhere on the large-scale map by setting the grid position of the localizer beacon on to Veeder-type counters and setting in the glide path angle, localizer bearing and frequency on switches on the console. Flying on the beam is then quite smooth down to touchdown although it is normal to break off the approach at an altitude of 300 ft.

Simulation of Emergencies

The faults panel attached to the port console carries the switches and controls for introducing flight conditions and emergencies in a manner best suited to rapid operation by the instructor. The controls are split functionally into areas, "Engine Faults" for example being grouped together separately from "Ancillary System Faults." The use of separate panels for each area makes for a certain flexibility of layout since individual groups can be re-designed without disturbing the whole.

The emergencies which may be set in are many and varied. They are based on the type of emergencies met with in practice and give the crew practice in dealing with emergency start procedures, engine failures due to various causes in the air, control failures and flight instrument failures. It is possible, too, to simulate emergencies arising from failures of hydraulic or electric systems.

Despite the compact size of the equipment, the specification and perfomance is that of a full flight simulator.

The use of DC analogue computing techniques, combined with the experience gained reducing the equipment necessary to produce given results, has evolved a simulator which is setting a new pattern for the future.

The extensive use of standard assemblies, and replaceable plugged units and the large reduction in volume of computing equipment can only be reflected in higher serviceability figures, easier maintenance and ultimately in lower first cost or the equipment.

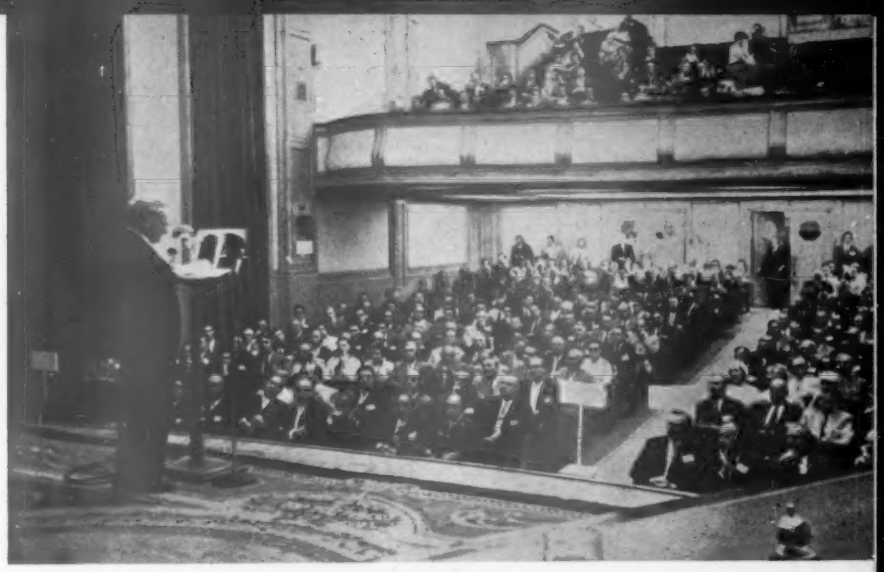
The choice of method and unit design used in this simulator bore fruit immediately on delivery to M.o.S. At the completion of acceptance trials on this prototype simulator, the machine was broken down from a running condition, packed, transported 120 miles, re-assembled and brought to a state ready for final approval by the customer, in one month.

The only failures on arrival on site were two of the 1,364 valves and up to the time of writing, the equipment has run trouble-free since then without interruption of training programme. The overall serviceability of the simulator is better than 98% including faults which have not affected the use of the equipment.

A general rear view of the Air Trainers Link Vulcan flight simulator.

Aeronautics International in Madrid

By J. R. Cownie, B.Sc.(Eng.), Grad. R.Ae.S.



Dr. Theodore von Kármán presenting the initial paper of the Congress.

MADRID was the venue for the First International Congress in the Aeronautical Sciences which was held between September 8-13. It was a truly international gathering, with representatives from Iron Curtain countries as well as the West. Russia sent a delegation of eight members of the Academy of Sciences, and an addition to the programme during the conference was a lecture on transonic flow problems by A. A. Doroditsyne, head of the Russian delegation. In all, 24 countries were represented by more than 600 delegates.

Organization of the conference was very smooth on the whole; there were four standard languages—English, French, Spanish and German—with translation facilities so that delegates could listen to lectures and discussions in any of these languages. Criticism of the organization was directed mainly at the supply of lecture pre-prints—only about two-thirds of the papers were available in printed form and none of the pre-prints could be obtained before the Congress began. These papers cost 3s. 6d. apiece, which proved unpopular with the delegates.

The late availability and in some cases the absence of pre-prints meant that lecture discussions were often of low quality. The programme was a concentrated one, and only about 10-15 min. were allowed for discussion after each lecture.

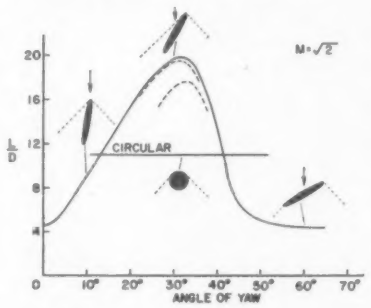
It would be preferable for future occasions if delegates were sent a complete set of pre-prints a week or two before the conference began; the cost of this could be covered by a larger registration fee. Delegates could then study the papers and make more effective contributions to the discussions and these could profitably be longer than they were at this initial conference.

Titles of all the lectures read at Madrid appear on page 475. Some interesting points made by lecturers on supersonic and hypersonic aerodynamics, ballistic-missile guidance, and aircraft noise appear below; developments in boundary-layer control, VTOL and STOL, materials and astronautic propulsion will be covered in THE AEROPLANE next week.

* * *

The opening lecture of the conference was by Dr. Theodore von Kármán, its honorary president. He began by paying tribute to Daniel and Florence Guggenheim, whose benefactions had made the Congress possible, and then went on to survey significant developments in aerodynamics since 1946. High supersonic speeds had originally led to simplification in theory, but this simplification had been counterbalanced by complications caused by the high temperatures resulting from shock and friction. These caused chemical changes such as dissociation and recombination. No longer were we dealing with pure aerodynamics: fluid mechanics must now be combined not only with thermodynamics but also with chemistry.

Another combination of sciences attracting considerable attention was fluid mechanics and the theory of the electro-magnetic field. The question of space flight and problems related to the possible use of thermonuclear reactions were involved. Dr. von Kármán felt that these branches of combined fluid mechanics, electro-magnetic theory and thermodynamics had not yet been systematically named and classified.



Variation of the L/D ratio with yaw for an elliptic wing at M = 1.414 is shown in this graph. Best L/D ratio is at about 30° of yaw.

Discussing detailed advances since 1946, Dr. von Kármán reviewed developments in the theory of supersonic wings. The requirements for minimum drag for supersonic wings had been established: one result of this had been the adoption of conical camber. Work on interference effects had led to the significant use of favourable interference known as the Area rule.

Favourable interference could also be created by reflecting compression and expansion waves on components by a lifting system: the classical example was the Busemann biplane. Another example was the combination of a horizontal delta wing with a vertical wedge surface beneath it parallel with the flight direction. Pressure created by the wedge surface was transferred to the lower surface of the wing. Total lift was increased and the lift-to-drag ratio was better than for a simple horizontal wing which gave the same lift.

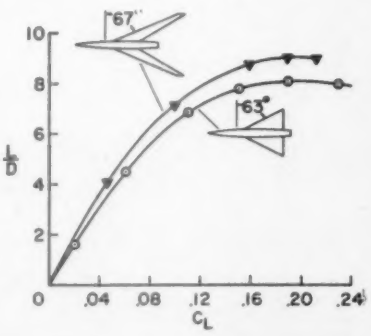
Other work described by Dr. von Kármán covered new theories for tackling aeroelastic problems and the flow around blunt bodies at hypersonic speeds.

Points from the Papers

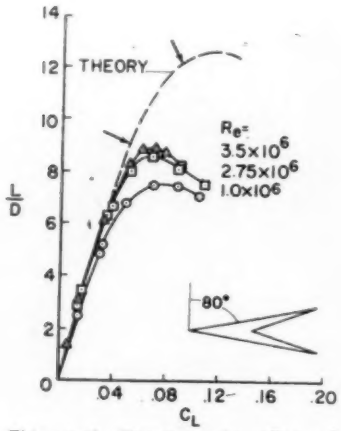
SUPERSONICS.—A yawed wing has a better lift-to-drag ratio than a swept one at supersonic speed. If a yawed wing is converted into a swept wing, its length in the flight direction is reduced by a half and its wave drag is increased. This leads to the suggestion of producing aircraft which are non-symmetric.

Swept wings have a somewhat better L/D ratio than rectangular or triangular wings except at the lowest Reynolds numbers. But narrow swept wings have a greater structural weight and a smaller usable lift coefficient for landing. Unless their potential L/D ratio can be approached more closely in practice, their use is difficult to justify in many applications.

At supersonic speeds the lifting system must have an extension in the flight direction if lift is to be produced with a minimum of shock-wave dissipation. Since the fuselage of a supersonic aircraft tends to be long and slender, the question of distributing part of the lift along it arises. To avoid undesirable peaks in the spanwise and lengthwise loadings where the wing meets the



Variation of L/D ratio with lift coefficient is shown for a delta and a slender swept-wing planform at M = 1.53.



This graph illustrates the effect of Reynolds number on L/D ratio at M = 1.53 for the cutout slim-delta planform shown.

fuselage, the fuselage should carry positive lift at the front and rear, but negative lift in the middle.

Large gains can be expected if this theoretical redistribution of lift by the fuselage can be achieved in practice, but lifting pressures needed on the fuselage are similar to those on the wing. At present, lift forces of this size cannot be achieved by bending or inclining a slender body of revolution without flow detachment. Future study of this favourable type of fuselage interference should be devoted to a means of preventing this flow breakaway.

At intermediate supersonic speeds, wave drag due to thickness can be reduced to small values by wave reflection. A great variety of three-dimensional toroidal shapes exist for which the wave system is entirely self-contained and wave resistance is zero at certain Mach numbers as in the Busemann biplane.

While wave drag associated with volume can be eliminated, such tubular bodies develop rather low L/D ratios. It seems that the added surface area to enclose the wave system increases the friction drag enough to counteract the gain in wave drag. At higher Mach numbers the friction drag becomes increasingly important relative to the thickness drag. Wave cancellation between interfering bodies or surfaces is more easily justified if the added surfaces are also desirable for other reasons such as stabilization or control.—(R. T. Jones.)

* * *

HYPERSONICS.—Theoretical work and experiment simulating flight conditions indicate that real-gas effects are of relatively small importance for high flight Reynolds numbers, considering the accuracy with which physical quantities can be determined. Pressure distributions and forces on simple boundary conditions can be obtained with simple rough approximations, with an accuracy often sufficient for engineering applications.—(Antonio Ferri.)

* * *

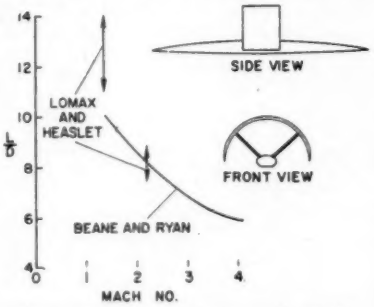
MISSILE GUIDANCE.—*The atmosphere introduces disturbing forces during the launch and powered phase of a ballistic missile and at its re-entry. Use can be made of aerodynamic forces during re-entry to control the flight-path of the re-entry vehicle.*

Guidance depends on the constraints which are put on missile trajectory. If the powered trajectory is completely predetermined, with motor cut-off at a predetermined point and missile velocity, the constraints on the missile are most severe, because it must follow a fixed flight path and thrust control is needed for the missile to arrive at each point on the trajectory at the appointed time. Minimum constraint will be achieved by omitting thrust control and cutting off the motors when the velocity vector is such that a free ballistic trajectory will carry the missile to its target.

At each point in space there is an infinite number of velocity vectors which will take the vehicle through its target. Each of these vectors represents an ellipse for the trajectory with the centre of the Earth as one focus. The smallest of these velocity vectors represents the maximum range for a given missile.

Some criterion must be decided to choose the particular velocity vector required for each point in space. Guidance is then applied by measuring the actual velocity of the missile, comparing it with the required velocity at that point, and then accelerating or decelerating the missile as required.

Between the two extremes requiring maximum and minimum restraints on the missile, there is a range of methods which require varying computer facilities to obtain the signals needed by the control system. The solution depends on whether the computer is on the ground or in the missile; in turn this depends on how



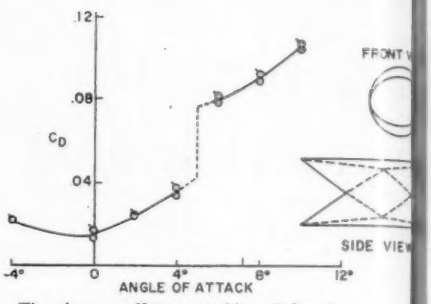
Variation of L/D ratio with Mach number is given for the arch wing and body illustrated. The names on the graph refer to studies made by Lomax and Heaslet of the NACA and Beane and Ryan of the Douglas Aircraft Co. The results indicate that the highly arched wing and body can have as high an L/D ratio at supersonic speeds as a swept wing and body.

measurements of missile position and velocity are to be made.

Guidance is terminated most conveniently soon after motor cut-off on all but short-range ballistic missiles, and velocity errors are of the greatest importance. Small velocity errors at cut-off cause large impact errors. Over the whole, trajectory errors in position maintain a more or less constant importance while the effect of velocity errors varies roughly in proportion to distance from target.

Two measurement techniques for guidance are radar and inertial navigation. They are complementary because the long-term accuracy of the radar system and the short-term accuracy of the inertial navigator are both high. Radar gives accurate measurements with a time lag and the inertial navigator gives accurate changes in velocity and position over a short time interval. A combination of these techniques should give much improved accuracy for ballistic missiles.

Guidance and control problems have largely been ignored by space-travel



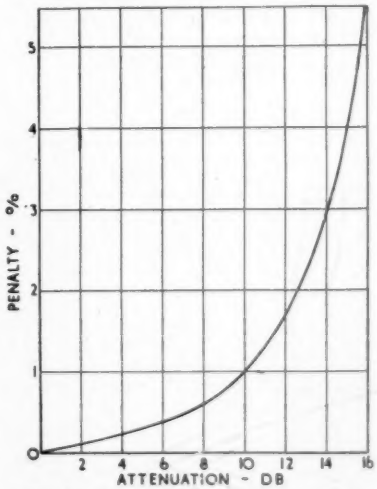
The drag coefficient at M = 2 for the body shown is plotted against angle of attack. Owing to shock-wave cancellation the body has negligible wave drag at the design Mach number of 2. At about 5° the wave system changes suddenly and the drag increases.

enthusiasts, the assumption being that suitable techniques will be developed at the right time to fit into the proposed designs of vehicles. It is suggested that this is the wrong approach; instead, the vehicle and propulsion system should be designed around the payload and the guidance and control system.—(W. H. Stephens.)

* * *

AIRCRAFT NOISE.—*Even with the most careful control of the variables the absolute noise level, measured on a given jet engine and nozzle under apparently constant conditions, varies over a period of time by as much as ±1.5 db in ground tests and ±3 db in flight tests. This appears to be distinct from normal experimental scatter.*

For 10-db noise attenuation an arbitrary figure of 1% has been chosen for the penalties applicable to take-off thrust, cruise specific fuel consumption, external drag during the cruise and weight penalty as a percentage of take-off thrust. These figures are in fact not far off actual practical values. In considering the effect on payload for a route involving operations limited by take-off, each 1% penalty costs between 1% and 2% in payload—that is 4% to 8% total.



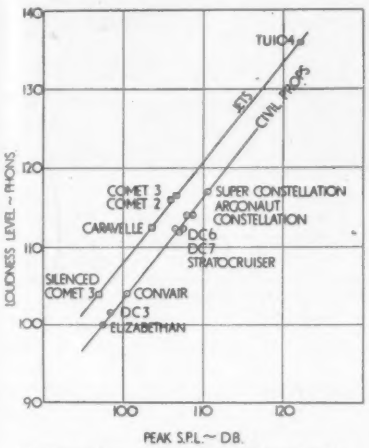
Penalties for noise reduction increase rapidly as the attenuation required goes above 10 decibels. The penalty is plotted as a percentage which applies simultaneously to take-off thrust, cruise specific fuel consumption, external drag during the cruise and silencer weight as a percentage of take-off thrust.

It seems prudent therefore to be practical rather than idealistic in choosing acceptable noise levels for the jet aircraft just going into service. If the level chosen is that of aircraft operating at present, the attenuations realized so far are not unreasonable. Obviously there may be methods of lowering the noise level already obtained, but it would seem that the reduction of penalties is of paramount importance at the present time.—(F. B. Greatrex and D. M. Brown.)

* * *

Lifetime exposure to jet- or piston-engine noise whose overall level exceeds 85 db may cause permanent hearing loss. The threshold of pain, which occurs at approximately 130 db for most individuals, has often been used as an index of whether a noise was harmful or not. However, this threshold is approximately 40-45 db higher than the threshold for damage to the hearing mechanism produced by lifetime exposure to noise.

In a recent study of hearing men experienced temporary hearing losses of as much as 84% after being exposed for 2 hr. to noise of less than 122 db. Approximately 180 hr. of non-exposure was required before these men regained their normal hearing.—(Keith K. Neely.)



This graph compares the loudness levels and peak sound pressure levels for a range of civil aircraft.

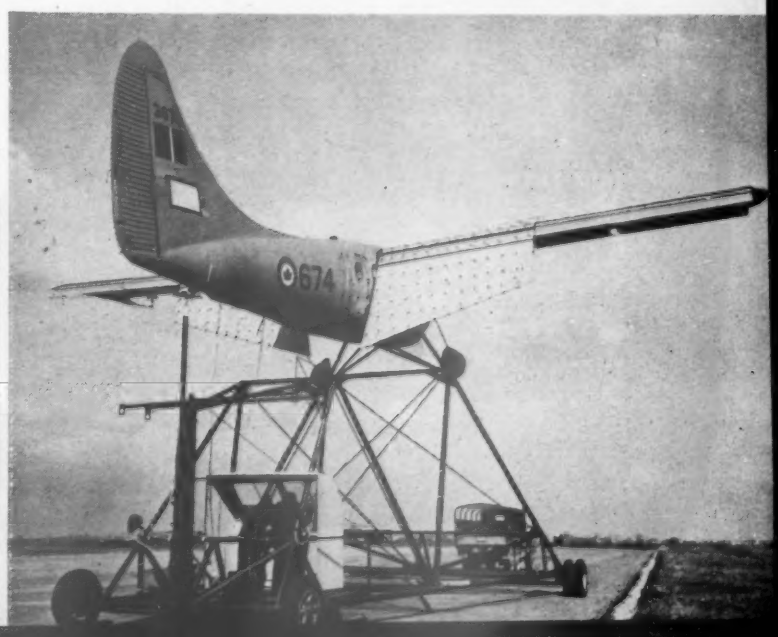
MADRID LECTURES

Some Significant Developments in Aerodynamics Since 1946 - - *Dr. Theodore von Karman*
Juan de la Cierva and His Contribution to the Development of Rotary Wing Aircraft *Pedro Blanco*
Aerodynamic Design for Supersonic Speeds - - - - - - - - - *Robert T. Jones*
Telecommand and Navigation - - - - - - - - - - - *W. H. Stephens*
Supersonic Propulsion by Turbojets and Ramjets - - - - - - - - *Maurice Roy*
Newtonian Flow Theory in Hypersonic Aerodynamics - - - - - - *Wallace D. Hayes*
Dynamics of a Dissociating Gas - - - - - - - - - - - *M. J. Lighthill*
Experimental Investigation of Hypervelocity Flight - - - - - - - - *J. Lukasiewicz*
Buckling and Post-Buckling Behaviour of Thermally Loaded Skin Panels- - *A. van der Neut*
Some Contributions to the Heat Conduction and Thermal Stress Analysis in Aircraft and Missile Structures - - - - - - - - - - - - - - - *Luigi Broglio*
Representation of a Thermoelastic Vibrating System Without and With Creep in the Direction of Vibration - - - - - - - - - - - - - - - - *R. Mazet*
Aerodynamic Derivatives for Oscillating Three-Dimensional Wings in Transonic Flow *Marten T. Landahl*
Mass Transfer Cooling, a Means to Protect High-Speed Aircraft - - - *Ernst R. G. Eckert*
Features of Hypersonic Heat Transfer - - *R. J. Monaghan, L. F. Crabtree and B. A. Woods*
Heat Transfer in Flows with Separation - - - - - - *R. Siestrunck and J. J. Bernard*
Heat Transfer by Natural Convection also at Critical State Conditions - - - *Ernst Schmidt*
Adiabatic Motion of a Gas in a Rotating Gas - - - - - - - *J. M. de Sendagorta*
Process in Jet Engine Noise Reduction - - - - - *F. B. Greatrex and D. M. Brown*
Noise Research in Canada: Physical and Bio-Acoustic - *Keith K. Neely, B. Etkin and H. S. Ribner*
Noise in Jet Transport - - - - - - - - - - - - - *William Littlewood*
Some Studies of the Effect of Jets on Structures - - *H. J. L. Le Boiteux and P. A. Lienard*
Some Considerations of Safety in Automatic Flight Control - - - - *A. M. A. Majendie*
Wander Phenomena in Oscillating Gyros on Gimbal Supports - - - - - *Kurt Magnus*
Principles of Inertial Guidance - - - - - *C. S. Draper, W. Wrigley and R. B. Woodbury*
Some Recent Developments in Boundary Layer Control - - - - - - *H. Schlichting*
Fundamental Design Problems of Aircraft with Boundary Layer Control for Maintaining Laminar Flow - - - - - - - - - - - - - - - - *G. V. Lachmann*
Theoretical and Experimental Contribution to the Study of Boundary-layer Control by Blowing *P. Carriere, E. Eichelbrenner and P. Poisson-Quinton*
The Use of Boundary Layer Control to Establish Free Stream-Line Flows - - *D. G. Hurley*
Aeroelastic Problems in Aircraft Construction - - - - - - - - *H. G. Kussner*
A Review of Some Recent Developments in Hypersonic Flow - - - - - *Antonio Ferri*
Problems of the Annular Wing Solved by Means of Rheoelectric Analogy *L. Malavard and G. Hacques*
Few Results of the Theory of Annular Wings in Incompressible Flow - - - *J. Weissinger*
Some Contributions to Problems of Transonic Flow - - - - - *A. A. Dorodnitsyne*
Research on VTOL and STOL Aircraft in the United States - - - - *John P. Campbell*
Safety and Reliability Aspects of VTOL - - - - - - - - - *D. Keith-Lucas*
Flight Mechanics of the Flying Power Plant Capable of Vertical Take-off and Landing *G. Eggers and G. Ernst*
Structures and Materials for Finite Lifetime - - - - - - - - - *N. J. Hoff*
Materials for Very High Temperature in Propulsion and Airframe Components - *Pol Duwez*
Heat-Resistant Materials—A Survey of Some British Developments - - - - *D. A. Oliver*
Telecommand and Telemetry for Pilotless Aircraft - - - - *R. A. Leslie and P. O. Gillard*
Transmission of Data by Radio from the U.S. Satellites - - - - - - *J. T. Mengel*
Prospects and Limitations of Human Flight Beyond the Atmosphere—The Elusive Spheres of Interest *Julian E. Ward and David G. Simons*
Disorientation in Flight - - - - - - - - - - - - *G. Melvill Jones*
Psycho-Physiological Limits of the Human Pilot and Flying Safety - - - - *E. Evrard*
Propulsion Methods in Astronautics - - - - - - - - - *W. E. Moeckel*
Physical Basis of Magneto-Hydrodynamics - - - - - - - - *W. B. Thompson*
A Comparison of Various Approaches to an Electric Propulsion System - - *Vernon H. Blackman*

Most of these papers can be obtained, price 3s. 6d. each, from the Pergamon Press, Ltd., London.

STOL-OTTER.—De Havilland Aircraft of Canada is experimenting, under a Department of Defense research contract, with a series of high-lift flaps and a modified tail on an Otter. The aircraft is mounted on a non-flying rig which is truck-towed along the runway at 45-50 m.p.h. The wing angles of attack can be varied.

Howard Levy photographs



Helicoptering by Remote Control

AN electronic device that permits a man on the ground to control a helicopter on the end of a 50-ft. tether has been developed by the Sikorsky Division of United Aircraft Corporation.

Many military and civil uses are anticipated for the tether system. As a helicopter pilot's visibility is somewhat restricted underneath the aircraft, the tether will help in hooking up loads to be carried externally in the cargo sling. One man at the electronic control can guide the helicopter while another man hooks up the cargo.

The controller of the device does not have to be a pilot in order to lead the helicopter around satisfactorily. It is claimed that any intelligent man can learn to guide a helicopter anywhere he wishes with only a couple of hours' instruction. The electronic equipment, which takes over complete control from the pilot, responds to tension and motion of the tether hanging down from the side of the cabin.

To put the electronic system into operation, the pilot brings his helicopter to a hover within 50 ft. of the ground and lowers the cable to the ground controller. He then engages the electronic sensing equipment to which the tether is attached and removes his hands and feet from the controls. Signal lights inform the ground controller when it is the time for him to take over and he can then make the helicopter rise or sink or move about as he wishes. In a case of emergency, the pilot can over-ride the tether system and regain command of his helicopter.

R.A.F.A. "Wings Day"

THIS YEAR the Royal Air Forces Association "Wings Day," which is held annually during Battle of Britain Week, falls tomorrow Saturday, September 20, and again coincides with the R.A.F. "At Home" day when a number of Service stations are open to the public.

During this week (September 15-21) branches of the R.A.F.A. everywhere have organized commemoration events, one being the Association's National "Wings Day" Appeal, when emblems in the form of wings are sold to the general public. All moneys derived from this appeal are devoted solely to welfare purposes and are kept entirely separate from the Association's administrative expenses.

The great need of most R.A.F.A. branches organizing "Wings Day" collections is for more collectors, and the Association would be most grateful if any readers able to volunteer their services in this connection would immediately contact the secretary of their local branch.

A Navigation Specialist

WE regret to record that Air Vice-Marshal Philip Herbert Mackworth, C.B., C.B.E., D.F.C., died in London on August 30. He was 60.

Joining the R.N.A.S. in 1916 he qualified as a pilot and flew on anti-submarine patrols. He was granted a permanent commission in the R.A.F. in 1919, and for a time operated flying-boats at Malta. Long-distance navigation was of great interest to him, and it was after leaving Malta that he began specializing in this subject.

HAMBLE PUPIL.—Winner of the 1957 Alan Marsh Memorial Trust Fund Award, for his rotary-wing work at the College of Aeronautics, Mr. K. F. Topp of Westland Aircraft, Ltd., is currently undergoing a course of helicopter flying experience with Air Service Training, Ltd. He is seen seated in a Hiller 12-C. His instructor is Mr. W. H. Anderson.

In 1926 he was a flight commander (under Wg. Cdr. C. W. H. Pulford) on the R.A.F.'s long-distance flight from Cairo to Cape Town and back to England by four Fairey IIIDs. After a period as navigation instructor at the Staff College he spent three years at the Air Ministry. In 1932 he became a flight commander of No. 216 (Bomber Transport) Squadron, flying Vickers Victorias in the Middle East, and then became the squadron's commanding officer.

He was back at the Air Ministry in 1936 as Wing Commander in charge of Navigational Policy, and was closely concerned with the strategical aspects of navigation which were to play so important a part in the Second World War. He was primarily responsible for the production of the Air Almanac and Tables, and for the Mk. IX averaging sextant.

He made several visits to North America in connection with the Joint Empire Training Plan, and was appointed S.A.S.O. of No. 1 Training Command in Toronto. In 1942 he became A.O.C. of No. 225 Group in India, and was Commandant of the Empire Central Navigation School in 1944-45.

For two years thereafter Mackworth, by then Air Cdre., was S.A.S.O., Coastal Command, and from 1947 to 1950, when he retired from the Service, was Air Officer, Administration, at H.Q., Transport Command.

NEW IN GERMANY.—The first German-built Nord Noratlas — of French design built under licence by the Flugzeugbau company of Hamburg - Finkenwärder—is seen here after ceremonial delivery to the German Army on September 9.

Canada's Biggest Air Show

AN estimated 100,000 people watched the Fifth Canadian International Air Show in Toronto on September 5. Held over Lake Ontario and in conjunction with the Canadian National Exhibition, the display was probably the biggest ever held in Canada.

The Show opened with a formation of 20 Harvards, as two Chipmunks wrote the letters R C A F against the blue sky. Nine T-33 Silver Stars, also trailing white smoke, made a bomb-burst and, before one could absorb the spectacle, a wedge of 25 Avro Canada CF-100s, Canadair Sabres and T-33s swept by.

The aircraft of the North American Air Defence Command were represented by a unique formation composed of a CF-100, F-89 Scorpion, F-102 Delta Dagger and F-104 Starfighter. This was followed by well-placed low-level aerobatics by Flt. Lt. R. Windover in a fluorescent-red Silver Star. His sharp pull-ups were remarkable. A specially modified T-33 then demonstrated a seat ejection, which surprised the pundits when two dummies shot from the rear seat.

Transport Command was represented by a formation made up of a Comet 1XB, a C-119G Packet and a C-54GM North Star. Maritime Air Command contributed three Canadair Arguses, their size cleverly illustrated by three Sabres which were tucked into their Vic. Two Neptunes followed.

The timing was so close that two and sometimes three acts appeared at the same time. On one occasion you could watch a Piasecki H-21A and a rescue launch pick up two live parachutists from the lake, while a Dakota circled low. Simultaneously a Chipmunk and a Harvard, each streaming red and white smoke from exhausts and wing tips, looped and looped and looped. Above their spectacular convulsions two CF-100s demonstrated a collision-course interception, while the calm controller's voice came over the loudspeakers.

An H-34 helicopter in unwarlike red, white and blue did some weight-lifting, and four Sabres plus four T-33s demonstrated the art of formation changing while orbiting low in front of the crowd.

The R.C.A.F. section of the show concluded with a mass fly-past of 60 aircraft. The jets, from the Starfighter to the T-33s, swept over in a massive anchor, while the piston-engined aircraft, which were preceded by a Comet 1XB, droned by at a lowed altitude.

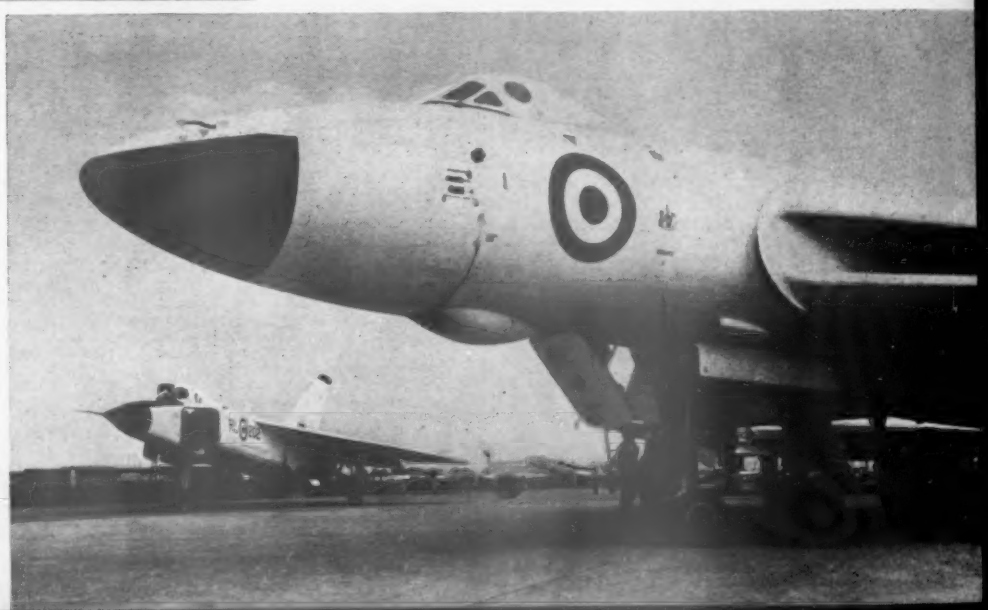
Bringing up the rear, and slightly ahead of schedule, was an R.A.F. Vulcan of No. 101 Squadron, which had flown the 3,570 miles from the S.B.A.C. Display at Farnborough in 7 hr. The commentator said the Vulcan was so short of fuel that it was making its approach on emergency procedures: afterwards we learnt this misunderstanding had arisen because the pilot had requested a straight-in approach. Later, an Otter amphibian and a Beaver floatplane landed inside the breakwater 40 ft. from the crowd.

The Lockheed Jetstar which had flown from Marietta, Ga., to appear in the air show and to be demonstrated to Canadian firms, was prohibited from appearing by the Department of Transport, because of its experimental licence. Meanwhile, Lockheed solicited deposits from interested corporations.

Eight Banshees of the Royal Canadian Navy flew past before the appearance of the U.S. Navy aerobatic team, the Blue Angels. Their formation flying was excellent as usual, but they were handicapped by having the Grumman Tiger of one of their two solo performers unserviceable. In addition, safety regulations, not observed by other participants, eliminated some manœuvres and kept the rest too far from the crowd.

In previous years the R.C.A.F.'s performance has usually been eclipsed by more spectacular shows by visitors. This year's display was first-class, with the R.C.A.F. more than holding its own. The September 6 display, at which the Avro Arrow was to have flown with a Vulcan, was cancelled because of poor weather.

Among the static displays was a replica of the Silver Dart, the first powered aircraft to fly in Canada. The R.C.A.F.-made model may fly next February at Baddeck, N.S., on the 50th anniversary of the first Canadian flight.—N.A.M.



VISITORS TO TORONTO.—Above, the crew which flew the Vulcan from the Farnborough Air Show to Toronto on September 5. Left to right, Sqn. Ldr. D. Skeen; Flg. Off. J. Ward; Flt. Lt. A. Howie; Flt. Lt. H. Swann; Flg. Off. B. Harris, and Ch. Tech. W. Neen. On the right the Vulcan is seen at Malton, Ontario, with, in the background, an Avro Aircraft Arrow all-weather fighter.

Private Flying

H.J.C.'s CLUB COMMENTARY

● AT THE last committee meeting of the **Popular Flying Association** certain personnel changes were made.

Through pressure of work on Royal Aero Club matters, Mr. Maurice O. Imray has found it necessary to resign as honorary secretary, and in future his duties will be taken over by Mr. Harold Best-Devereux, who will now be responsible for most of the running of the Association. He will have a full-time assistant, probably Miss Jill Exell, of the R.Ae.C. Air Touring Department.

Maurice Imray will become honorary treasurer, a post hitherto held by Col. Preston, the R.Ae.C.'s secretary-general, and will remain on the committee. He has been P.F.A. secretary since 1951, and was a member of the original Ultra Light Aircraft Association.

The president of the P.F.A. is Mr. Peter G. Masefield; the vice-president, Lord Sempill.

● A MOVE is afoot to resume flying at Waltham aerodrome, Grimsby, which was requisitioned by the R.A.F. 20 years ago and since the War has been inactive.

The **Grimsby and District Flying Club** has been formed by a group of local enthusiasts; already there are about 30 members, but the club wants to double this number before getting an aeroplane, which will probably be a Tiger Moth.

The club has permission to use the runways, and has taken over the control tower, which is being renovated for use as a clubhouse.

The secretary is Mr. Bernard Pike, and anyone interested in joining the club should contact him at 16 Ainslie Street, Grimsby. Acting as business manager is Mr. T. D. Marsden.

● GRIMSBY AERODROME was officially opened on June 10, 1933, by Maj. R. H. S. Mealing, of the Air Ministry's Department of Civil Aviation. President of the Lincolnshire Aero Club, which occupied the aerodrome, was Brig.-Gen. C. G. Hoare, and the flying side was directed by Mr. W. West and Capt. Norman Blackburn. It is of some interest that at the opening air display a Ford Trimotor was demonstrated by Capt Neville Stack, and Mr. C. E. Gardner, later to win the King's Cup race twice, won a 30-mile local race flying an Avro Cadet.

The Humber Air Ferry was operated between Grimsby and Hull (Hedon aerodrome) for a short time in 1933, the 15-min. trip costing 7s. single and 12s. return. It was run jointly by the North Sea Aerial and General Transport Co., Ltd., and East Yorkshire Motor Services, Ltd.

Just before the War, in 1939, the Grimsby Corporation bought the 300-acre site at Waltham, but the War put a stop to its development as a municipal aerodrome.

● ALSO in that locality is the **Humber Flying Group** (P.F.A. No. 140), which flies an Auster 5, G-ALYB, from Skegness aerodrome.

CROYDON PUPIL.—Miss Mary Privett, 19, of Epsom, is learning to fly with the Surrey Flying Club.

● IN JUNE the **Oxford Aeroplane Club** flew a total of 175 hr., although, as elsewhere, the weather at Kidlington has been specially bad. Mr. D. Hayward flew his first solo during the month; in the following month G. Nixey flew solo, and N. Bartlet gained his P.P.L.

A.T.C. cadets are now at Kidlington, taking lessons under the scholarship scheme.

Gliding Notes

by Dr. A. E. Slater

LONDON Gliding Club's Aerobatic Competition is now established as an annual event. The first one, held last year, went off in fine style, and the second is to be held in two days' time, on Sunday, September 21. Flying should start about 11.00 hrs.; admission for adults is 1s., refreshments will be laid on, and there is a car park. The site, as everyone should know, is Dunstable Downs, 1¼ miles S.W. of Dunstable.

Entries are limited to 25. Among those coming are three competitors from the R.A.F., including Andy Gough with an Olympia 419; also Dan Smith in Slingsby's new Swallow, David Ince in the Olympia 415, Arthur Doughty in a Kite 2, two Prefects from Coventry, and about nine entries from Lasham.

Competitors will be aero-towed to 2,500 ft., and we had better add that this is 750 m., because Maj. Oliver Stewart is to be chairman of the judges' panel, as last year. He is expected to be assisted by the same judges: Air Cdre. A. H. Wheeler, Mr. Jeffrey Quill, Mr. Maurice Imray, Mr. Geoffrey Tyson, Mr. Hubert Broad, Wg. Cdr. H. P. Powell and Sqn. Ldr. C. K. Turner-Hughes. A. W. "Bill" Bedford will, as before, advise the panel on how glider aerobatics differ from other kinds. Various other spectacles will be laid on, and there will be passenger flights in two-seaters.

* * *

THREE Gold "C" climbs in succession were made by Peter Collier from the Bristol Gliding Club on August 12 in the club Skylark. First, he was winched up into immediate contact with lift going up into a cumulo-nimbus and reached 11,500 ft.; but after coming down he found that the barograph cylinder had not been turning. So he got it to work properly, was launched again, and went up to 12,000 ft. Before landing after the descent he thought he might as well make sure by going up once more to 12,000 ft., which he proceeded to do.

A similar climb was made from the Derbyshire and Lancashire Club at Camphill on July 29 when, in a privately owned T-42, Carl Birkett and Michael Kaye went up to 12,000 ft. a.s.l. and from that height descended at high speed to Brough Aerodrome, 58 miles away, in 40 min.

Blackpool and Fylde Gliding Club, who find their Squires Gate site good for training, but too near the sea for adequate thermals, tried out a hill site on August 10 for the first time. It is Nicky Nook Fell, a westerly offshoot from the Pennines, near Garstang, and it provided good soaring for Jack Aked in a south-westerly wind; but there was only a narrow strip between bracken to land on. However, the farmer has promised to make a larger clearing.

Lasham has had a visit from Heinz Pertzborn, who is gliding correspondent of the German magazine *Flug Revue*. He flew Skylarks 2 and 3 and an Eagle, and then visited Elliotts of Newbury, and tried out Olympias 419 and 415. Elliotts are busy now making 24 new Olympias of the Mark II type. Four are just being sent to Pakistan and many of the remainder are for the R.A.F. Gliding and Soaring Association.

* * *

IT used to be said that a long ridge with a steep slope is an asset to a gliding club only so long as the wind blows up it. But now, with the exploitation of lee waves, hopes (and sometimes sailplanes) are also raised when the wind is found to be blowing down it, because the upward rebound can, on occasion, carry a sailplane higher than any plain honest upslope wind is able to do. Scottish Gliding Union members have often watched lenticular clouds forming in an east wind to leeward of Bishop Hill, and during National Gliding Week recently, Bill Lawson showed a time-lapse film he had made to demonstrate how these clouds behaved.

On August 24 a club member contacted this lee wave for the first time. Shortly before 20.00 hrs. (B.S.T.) a cloud cap formed on the hill top and its substance poured some way down the steep west slope before evaporating. Soon, puffs of cloud appeared also half a mile to leeward, at 1,000 ft. or less, and before long had joined up and grown into a cloud mass 1,500 ft. thick, which then extended itself further to leeward with regular variations in thickness, suggesting a whole train of stationary waves. Next, there appeared lenticular clouds at a higher level, with "small feathery streaks" cascading down on the down-wave side.

This impressive sight was enough to induce Jack Alcock to get an aero-tow in the club Olympia to the upwind side of the lower cloud mass, whose top had grown to 4,000 ft. by this time. Sure enough, there was 10 ft./sec. lift, but it did not extend back into the upwind edge of the cloud, nor any higher than the level of the cloud top. It was too late in the day to go exploring for more waves downwind; but this was not just bad luck—it is the usual story, because these waves commonly improve with oncoming darkness because the air becomes more stable.

On this occasion the onset of waves must have been precipitated by the arrival of a new air mass, as the sudden appearance of a "cap" on Bishop Hill showed, rather than mere stability. Denis Bryce, who sends this news, got the met. details from Leuchars, where humidity was high at 18.00 hrs. up to 5,000 ft. The noon radio-sonde there showed very unstable air up to 2,000 ft. at least, so the absence of a lee wave earlier in the day is not surprising. The wind at 18.00 hrs., from between N.E. and E., blew at 11 knots both at the surface and at 3,000 ft., and then fell off to only 3 knots at 5,000 ft.; this may explain the height limit of the lift.

A very low cloud base has been similarly characteristic of some lee waves at Long Mynd and Dunstable.

Correspondence

British Sailplane Prospects

RATHER late in the day, I should like to take up Peter Brooks (THE AEROPLANE, August 8 and 15) and Mr. Shenstone (THE AEROPLANE, July 11) on their post-Leszno assessments of British sailplanes.

Let us see what a foreigner says. In the September *Aviasport* a description of the Skylark 3B starts, "*C'est au fond la vainqueur de Leszno avec Goodhart si nous éliminons l'H.K.S. et son detecteur d'ascendances. Voilà un planeur simple de construction. . . . Pas de volets a n positions, pas de trains rentrant. Ou économiseration sur un Breguet 901, en poids et en prix, en supprimant le train rentrant?*"

Do not let anyone criticize our sailplanes, because they do not incorporate modern devices which we cannot afford.

Let us look around the World a bit. In New Zealand the sailplanes population is roughly half each German and British. Every single flight of note to date has been done in a British machine—Skylark 2, 3 or Eagle. In Canada, as soon as someone imported a Skylark 3 it won the Nationals against a field of largely American sailplanes. In Rhodesia Eric Burdett imported a Skylark 2 and things started to hum at once. He took it to the South African Nationals and staggered everyone with his performances, getting the first 500-km. Diamond in the Commonwealth, and flying against much larger aircraft, mostly German. The story is broadly the same in Argentine and in Spain and in Holland.

As I see it, we have been so far in the lead in "sensible" sailplanes since the War that we are now startled to find others—mainly the Germans—catching up. German aircraft have for years been cheaper than ours, but nothing like as good. They are still not as good, but the margin is now narrower in quality, but still as much in their favour in price.

We cannot reduce our wage-rates to the German level, so must re-establish our margin of quality superiority. The effort will be good for us.

There remains the larger long-range problem of getting into the new generation of plastic sailplanes foreshadowed at Leszno by the Breguet 905. Whether the expensive research necessary to achieve this can be done by a small and unsubsidized industry such as ours is a crucial question on which turns our prospects in the middle 1960s.

PHILIP WILLS.

Henley-on-Thames, Oxfordshire.

First Over the Atlantic

IN THE AEROPLANE of August 15 you printed a letter from a Mr. Graham Wallace, who seems to believe that our generation "believe that Lindbergh's was the first transatlantic flight."

I believe that Lindbergh's was the first *solo* transatlantic flight and is this not true? My brother and I have never thought it was the first flight across the Atlantic, but as we are both ardent flying fans it is not surprising. As Mr. Wallace says, there are, no doubt, hundreds of our generation who do not know this, but need he include those who do know into that category?

Southport. LESLEY MUNRO (aged 15).

[Our correspondent is quite right about Lindbergh making the first solo flight over the Atlantic: but production of the Alcock and Brown film would have dispelled the belief—which undoubtedly does exist, particularly on the other side of the Atlantic—that his flight was the first ever.—ED.]

Lighter-than-air Technicalities

I HAVE just received the August 1 number of THE AEROPLANE and have read with interest the note on "Airships in Germany." I would like to make one or two comments.

In the first place, the speed and power figures quoted for the LZ.132 imply that the designers have used a drag coefficient some 20% lower than was realized in such ships as the "Hindenburg" and "Macon," or are assuming a similar improvement in propulsive efficiency. While such improvements are not implausible, one would be interested in knowing whether they have any experimental foundation.

Some time ago I was a member of a group engaged in a design study for a large rigid airship with nuclear propulsion, for A.E.W. service at high altitudes (up to 20,000 ft.). It was found that such an airship would be perfectly feasible, but for various reasons connected mainly with the nuclear powerplant was not too attractive. After the conclusion of this study, it was decided to investigate briefly the commercial potentialities of a ship of similar size and aerodynamic characteristics. The size, which had been fixed by the dimensions of the hangars at Moffet Field and South Weymouth, was 12,500,000 cu. ft. air volume.

Naturally, a very extensive redesign was called for, and this was only approximately carried out; for instance, only three or four loading cases were considered in the strength calculations. The girders were assumed to be of a recently developed alloy, X2020-T6, and the wiring of titanium alloy corresponding to Hylite 50. Water-cooled two-stroke Diesel engines were assumed, with specific weight and fuel consumption equivalent to the Jumos of 1939. Top speed was fixed at 85 m.p.h. at 3,000 ft., and the route chosen for analysis was San Francisco to Tokyo via Honolulu and Wake Island.

It was found that the total fixed weights came to only 172,000 lb., out of a gross lift of 675,000 lb. Over the longest stage, San Francisco to Honolulu, 46,000 lb. of fuel would be consumed (in still air) and a payload of 375,000 lb. could be carried. If swivelling propellers were used, as in the "Akron" and "Macon," with 30,000-lb. static thrust, the payload would be increased to 403,000 lb. (the increased drag of flying heavy for the first 1,500 miles accounts for the missing ton).

I have applied Normand's method to a comparison of this design with the LZ.132 proposal. Normand's coefficient, or growth factor, is about 2.1. Lord Ventry's figures indicate an increase in duration of about 37%, in top speed of 18%, and in cruising speed of about 30%, compared to the design we studied. If the weight of 100 passengers, their quarters, food and water be taken as about 75,000 lb., it is found that a displacement of some 7,000,000 cu. ft. is required. Of course, such a large change in size is beyond the range of accuracy of Normand's method, and in any event there is not really enough information to say whether the two proposals are in fact comparable.

My study of the economics of a trans-Pacific airship route has not been completed, mainly because figures for maintenance, repair and overhead costs have been difficult to assemble. No doubt Capt. Pruss and his associates are in a much happier situation in this respect. I would be very grateful if Lord Ventry could inform me whether the reports he discusses are available and, if so, to whom a request for copies might be addressed.

G.P.O. Box 1218, DONALD WOODWARD.
New York, 1, N.Y.

Derby History

THIS group of companies will celebrate its coming-of-age next year, and we are in the throes of preparing a suitable booklet to cover, in illustrated form, its past, present and proposed future. However, suitable photographs of the early days seem to have strayed, and if any reader is able to lend us a picture or pictures of the R.A.F. Harts or Hinds with which the first school was originally equipped in 1938, preferably showing some aerodrome buildings that definitely pinpoint the base as Derby (Burnaston), I will personally ensure that anything sent is returned as quickly as possible.

Elstree Aerodrome, DAVID F. OGILVY,
Herts. Manager, Derby Aviation, Ltd.

Plane Names

THE Lightning was known so long as the P.1B, often misprinted as Pib, that young R.A.F. pilots who have been incessantly expecting it for so long are already calling it the Pib for short. Most popular aeroplanes have had affectionate nicknames in the R.A.F. and the Pib will worthily follow the Spit, Mossy, Stringbag and others.

So here's to the Pib and good luck to all who fly in it!

London, S.W.5. GEOFFREY DORMAN.

TO WREGULAR WREADERS.—I've broken through the Rain Barrier for two weeks.—WRIVIERA WREN.

NOTES AND EVENTS

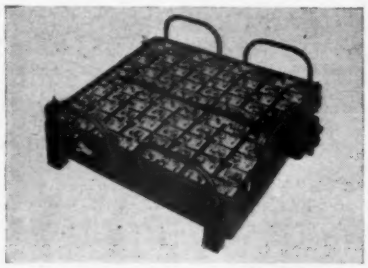
FIELD AT FARNBOROUGH.—At the S.B.A.C. show Field Aircraft Services, Ltd., illustrated their wide range of facilities for aircraft, engine and instrument servicing and manufacture. Recently expanding to Wymeswold aerodrome and opening a new metal shop at Croydon at the start of this year, the company undertakes aircraft repairs, modifications and conversions, engine overhauls, general servicing, and propeller and instrument work. In addition, Field manufacture a number of components and operate aircraft salvage operations.

CELLON TAKE-OVER. — Group Developments, Ltd. (a subsidiary of Courtaulds, Ltd.), has acquired the ordinary share capital of Cellon, Ltd., of Kingston-on-Thames. Both Cellon, Ltd., and its associate company, Merry and Minton, Ltd., will continue to manufacture a wide range of aircraft and other paints, and the additional technical resources arising from the association will be of material assistance to the two companies in keeping pace with development and maintaining a high standard of technical service.

ATC EQUIPMENT.—The British Communications Corpn. is to supply a number of M.A.R.S. installations (multi-channel automatic recording system) to the U.S.A.F. for use in radar ATC centres in the United Kinedom. This type of equipment is currently being supplied to the M.T.C.A. and the R.A.F. to meet a major ATC installation programme and is in operation at the London and Gatwick Airports.

CANADIAN COMPUTER. — As a joint venture, Short Bros. and Harland, Ltd., and the Bristol Aeroplane Co. of Canada, Ltd., are to ship a Short general-purpose analogue computer to Canada. It will be installed in the Department of Electrical Engineering at McGill University, Montreal, where it will be used for research on electrical-circuit design and control-system analysis. It is hoped that besides being used for research, the computer will be available for use by other organizations and for demonstration.

HUMIDITY DETECTOR. — A new electrical device designed to protect packaged stores by detecting moisture before damage can be caused, is being developed by the Export Packing Service, Ltd., and E.M.I. Electronics, Ltd. It



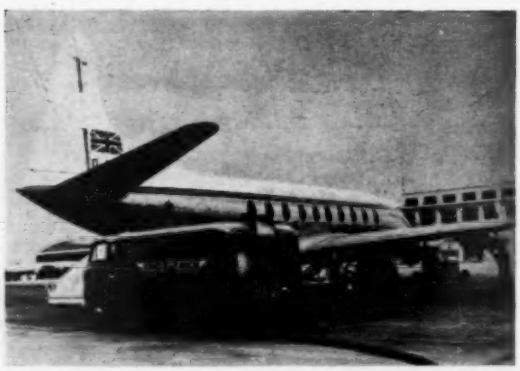
FOR ELAND-STARTING.—A Venner 120-V. lightweight silver-zinc starter battery of 70 a.h. capacity and weighing 226 lb. is fitted to the Fairey Rotodyne VTOL airliner. The battery measures 23 in. by 25 in. by 7 in. high.

enables the relative humidity inside a package to be tested without the necessity of visual observation through a transparent panel, and consists of a sensitive element—fitted in each package—and a portable instrument used to make checks during periodic inspection.

FILTER PRODUCTION. — Palmer Aero Products, Ltd., has announced that, following a recently concluded licensing agreement with Parmatic Engineering, Ltd., of Ontario, Canada, it is now manufacturing filters of wide and varied application which will be marketed under the name "Palmer-Parmatic." These filters are fitted to the R.C.A.F. Avro CF-100 and Avro Arrow all-weather fighters.

AIRBORNE RADAR CONTRACT.—Orders worth more than $1 million have been placed with E.M.I. Electronics, Ltd., for an advanced-type airborne radar equipment for use in aircraft of the R.C.A.F. The radar equipment is the latest aid to submarine detection, and it is being fitted in the Canadair Argus.

MEASUREMENT OF SPEED.—Marconi's Wireless Telegraph Co., Ltd., announces the production of a new instrument which has wide application in the accurate measurement of the speeds of guided weapons, projectiles, rockets, aircraft or ground vehicles. The equipment, known as EVA (Electronic Velocity Analyser), is stated to overcome many of the difficulties with which trials staffs of Service establishments are faced in the task of computing performance figures.



VISCOUNT REFUELLING.—A Karrier Bantam mobile hydrant dispenser, fitted with Truro twin-hose motorized equipment, is seen here refuelling a B.E.A. Viscount at Portela Airport, Lisbon. Fuel is delivered at pressures up to 90 p.s.i.

Aviation Calendar

September 20. — Aviation Forum of London annual dinner, at the Aerodrome Hotel, **Croydon,** Surrey.

September 21.—Sailplane aerobatic competition organized by the London Gliding Club, at **Dunstable,** Beds.

September 21.—Air Rally organized by the Milan Aero Club, at **Milan.**

September 21.—Royal Belgian Aero Club international concourse for balloons, **Brussels.**

September 21.—Denham Flying Club garden party, at 14.30 hrs., at **Denham.**

September 24. — R.Ae.S. Manchester Branch lecture, "Why Airlines are Hard to Please," by B. S. Shenstone, M.Sc., F.R.Ae.S., A.F.I.Ae.S. (B.E.A.), in the Reynolds Hall, College of Technology, **Manchester,** at 19.30 hrs.

September 25.—R.Ae.S. Graduates and Students Section lecture, "The Next Generation of Civil Aircraft," by G. H. Lee (Handley Page, Ltd.), in the Library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

September 25-26. — Aerodrome Owners Association annual conference, at the Hyde Park Hotel, **London,** W.1.

September 26-29.—Austrian Aero Club Rally at **Innsbruck.**

September 27-28.—"Tipsy Week-end" organized by the A.S. Flying Club, at Baginton Airport, **Coventry.**

September 30.—R.Ae.S. London Airport Branch lecture, "The 707," by M. Pennell (chief engineer, Boeing Airplane Co.) in the Senior Mess Club, 4th Floor, B.O.A.C. H.Q., **London Airport,** at 18.00 hrs.

October 4.—Aviation Forum of London lecture, "The Channel Air Bridge," by Douglas Whybrow, at the Imperial Hotel, Elizabeth Street, Victoria, **London,** S.W.1, at 19.00 hrs.

October 8.—R.Ae.S. Manchester Branch lecture, "Some Problems of Supersonic Flight," by L. P. Twiss, O.B.E., D.S.C., A.F.R.Ae.S. (Fairey Aviation Co.), in the Reynolds Hall, College of Technology, **Manchester,** at 19.30 hrs.

October 9.—Society of Instrument Technology, Control Section lecture, "Aircraft Flight Simulators," by Dr. A. E. Cutler, B.Sc., Ph.D., at Manson House, Portland Place, **London,** W.1, at 17.30 hrs.

October 16. — R.Ae.S. Graduates and Students Section lecture, "The Fatigue of Aircraft," by Maj. P. L. Teed (Vickers-Armstrongs), in the Library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

October 21.—R.Ae.S. Luton Branch lecture, "Fatigue Testing of the Fokker Friendship," by E. J. van Beek (Fokker), in the Napier senior staff canteen, **Luton Airport,** at 18.15 hrs.

October 23-24.—GATCO Convention at **Southend-on-Sea,** Essex.

October 29.—R.Ae.S. Graduates and Students section, film show, in the Library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

October 29.—R.Ae.S. London Airport Branch, Brains Trust, in the Senior Mess Club, 4th Floor, B.O.A.C. H.Q., **London Airport,** at 18.00 hrs.

Company Notices

NEW COMPANY

Brantly Helicopters, Ltd. (610,554).—Private co. Reg. Sept. 1. Cap. £25,000 in £1 shs. Objects: To carry on the business of manufacturers of and dealers in helicopters, aircraft, etc. Subscribers (each with one sh.): R. F. Daniel, "Birchwood," Lake Rd., Virginia Water, Surrey, company director; Penn Elastic Co., Ltd., Ystrad Rd., Fforestfach, Swansea. First directors not named. Solrs.: Stephenson Harwood and Tatham, London, E.C.2. Reg. off.: c/o Penn Elastic Co., Ltd., Ystrad Rd., Swansea Trading Estate, Fforestfach, Swansea.

New Patents

APPLICATIONS ACCEPTED

803,572.—Sperry Gyroscope Co., Ltd.—"Control systems for aircraft."—Feb. 22, 1955 (March 17, 1954).

803,574.—Sperry Gyroscope Co., Ltd.—"Control systems for aircraft."—July 15, 1955 (Aug. 25, 1954).

803,575.—Sperry Gyroscope Co., Ltd.—"Aircraft."—July 12, 1956 (July 29, 1955).

803,576.—Sperry Gyroscope Co., Ltd.—"Control systems for aircraft."—Feb. 22, 1955 (March 17, 1954). (Divided out of 803,572.)

803,577.—Sperry Gyroscope Co., Ltd.—"Control systems for aircraft."—Feb. 22, 1955 (March 17, 1954). (Divided out of 803,572.)

803,531.—Hymatic Engineering Co., Ltd.—"Personal service connectors for the crews of aircraft."—Feb. 13, 1957 (Feb. 24, 1956). (Addition to 786,078.)

Applications open to public inspection on Oct. 29, 1958; opposition period expires on Jan. 29, 1959.